University of Alberta

Principal-Agent Problems and Capital Constraints in Canadian Agribusiness Supply and Marketing Co-operatives

by

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Canada

Dedicated to

My late
Grandma - Desta
Stepfather – Emanuel
Aunt – Workie
Friend – Dufera

Abstract

The issue around capital constraints in co-operatives has attracted public attention in Canada and elsewhere. In this dissertation, the effect of the degree of financial leveraging on the performance of co-operative organizations is assessed using a combination of case study, cross-sectional and longitudinal survey techniques. Using rigorous econometric methods this study addresses the following questions: (i) What are the impacts of excessive debt on agribusiness co-operative performance? (ii) Are both supply and marketing co-operatives equally affected by the issues around capital constraints? (iii) What is the impact of differences in risk attitude between managers and directors on the financial leverage of co-operatives and members' welfare? and iv) What is the impact of excessive debt on the efficiency of agribusiness co-operatives organizations?

In the first paper, the impact of agency costs of debt on variable costs of production is explored using variable cost functions. The results indicate that the existence of agency costs of debt may be contingent on the structure of the co-operative and the industry regulatory environment. The results in the second paper suggest that as compared to managers, directors tend to have more favourable attitudes towards a higher debt-to-equity ratio. The results from the illustrative simulation indicate that the more averse decision makers are to risk, the lower the empirically determined values of members' welfare. Furthermore, the simulation results illustrated that the impacts of differences in risk attitudes may depend on the influence of decision makers.

In the third paper, the results from a random parameters stochastic frontier model indicate that costs could have been reduced by more than 15 per cent had the firms been on their cost frontier. Further analysis shows that leveraging has a negative influence on efficiency of firms in all industries investigated, except for firms in the feed mill industry.

The empirical results in this study suggest that obtaining more equity capital might be a necessary condition for overcoming the capital constraint problems in agricultural co-operatives. Thus, an incentive mechanism that may stimulate co-operative members and community involvement to strengthen the equity capital base needed to compete in the market place is necessary.

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Chapter 1: **Introduction**

1.1 Canadian Agribusiness Co-operative Sector Background

The agriculture and agri-food sector is one of the country's top five industries. It accounts for more than 8 per cent of the Canadian GDP (Gross Domestic Product) and is the third largest employer (Agriculture and Agri-Food Canada, 2003). Every year, Canada exports more than 24 billion dollars worth of agricultural and food products around the world. Canadian agricultural producers' exports represent about one-half of all agricultural production, either in terms of direct sales or as an input into a product which is eventually exported. Thus, it can be argued that the success of the Canadian agriculture and agri-food sector depends in large part on international markets, which are increasingly competitive. In the Canadian agribusiness sector, both co-operative and multinational firms play an important role in processing and marketing farm inputs and agricultural products.

> *In the food manufacturing sector, co-operatives represent approximately 20 per cent of the total shipments, with multinationals controlling over 50 per cent of the total shipments* (Ernst and Young, 2002:38).

It is also important to note that the importance of agricultural co-operatives varies across provinces. For example, agricultural co-operatives in Quebec contribute nearly 60 per cent of the farm input market and more than 50 per cent of agricultural product marketing and processing (Hébert, 2001).

In 2001, there were more than 10,000 co-operative organizations and credit unions in Canada with approximately 10 million members, more than $160 billion in assets, and approximately 160,000 employees (Canadian Co-operative Association, 2004). In 2001, there were approximately 5,678 non-financial co-operatives reporting to the Co-operative Secretariat[1], representing 5.0 million members, $29.5 billion total revenue, $17.9 billion in assets and employing 87,000 people. Of these co-operatives 976 (1300 including non-reporting) had an agricultural base, and represented 474,449 members and employed 38,387 individuals with total revenues of $18.2 billion and assets of $7.1 billion (McCagg, 2003).

In Canadian agriculture, co-operatives have played an important economic role as indicated by their substantial asset ownership **(Table 1-1)** and market share **(Table 1-2)**. Despite the contribution to the economy, the 1980's and 1990's brought several threats and opportunities that were introduced through (i) structural changes in international markets and food retailing sectors, (ii) international trade agreements, (iii) declining margins, (iv) changes in domestic policies such as the removal of the Western Grain Transportation Act (Goddard, 2002; Stefanson and Fulton, 1997) and the challenges to the Canadian Wheat Board and loss of government support programs (Stefanson and Fulton, 1997), (v) the world-wide trend of agro-industrialisation (Barry, 1995) (vi) decreasing barriers to capital transfers, and (vii) the increasing importance of the stock company (Sven, 1992). In response to the changes related to increased consumer's requirements for quality assurance, supply reliability, food ingredient specification, food safety, extended availability and greater variety, food retailers were demanding "capital-intensive" changes to farm production and food processing (Plunkett and Kingwell, 2001). For example, the larger Western Canadian grain co-operatives have faced considerable challenges due to deregulation, competition from multi-nationals, the rapid globalization of markets, fluctuating commodity prices, volatile climate, erosion of co-operative solidarity, aging members wishing to retrieve their capital investments, and the consolidation of industry players.

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[1] The Co-operatives Secretariat was created in 1987 from the Co-operatives Section of Agriculture Canada to improve the relationship between Canadian co-operatives and the numerous federal departments and agencies known to have legislation or policies affecting co-operatives.

According to Plunkett and Kingwell (2001:1), agro-industrialisation affects the nature of farm production, marketing and food processing:

> *...agro-industrialisation generally refers to the process of increased concentration and vertical co-ordination by agri-food firms through contract and supply chain management, along with the increased provision of farm inputs by off-farm businesses. It leads to competition not just between farms but also competition between supply chains in different regions and different countries.*

Since co-operatives operate in the same economic environment as investor owned firms (IOFs), the above changes led to intensive global and local competitive rivalry. This, in turn, required co-operatives to look for efficiencies and effectiveness through consolidation, construction of larger scale plants, acquisition of other businesses to increase their scale, and upgrading and automation (more capital-intensive investment). Over the years, the co-operative sector in Canada has significantly increased its capital investment as evident from **Figure 1-1**. **Figure 1-1** shows the real capital investment of the co-operative sector for the period 1963-2002. These capital investment activities include acquisition of businesses, purchase of property, plant and equipment, investment in other co-operatives, and other investment activities.

There is a sharp increase in capital investment during the 1963-71 and 1989-2002 periods. The sharp increase in capital investment during the 1989-2002 period coincides with an increased pace of consolidation and concentration. The soaring real capital investment is accompanied by increased dependence on debt financing (**Figure 1-1**). The co-operative sector has increased its debt-to-equity ratio[2] over the years, from approximately 1.13 in 1963 to 2.08 in 2000. Debt-to-equity ratios measure a firm's borrowing capacity. The heavier its debt load, the more earnings must be used to pay down debt instead of growing the business. Over the period 1963-2002, equity capital has been increasing at a rate of 7.7 per cent annually, whereas long term debt has been increasing at approximately 13 per cent annually[3]. Thus, the growth in debt-to-equity ratio may be attributed to an increased dependence on debt capital.

In line with the above facts, over the past two decades, a number of agricultural co-operatives in Canada have experienced financial difficulties because of their capital structure or excessive level of debt and inadequate capitalization (Goddard, 2002). That is, co-operatives are faced with capitalization challenges and some of them are still limited in their ability to react quickly to changing market conditions. When (i) significant amounts of capital are needed to make investments, (ii) members need access to their equity capital or (iii) equity capital is low, then the co-operative may be forced to borrow more capital from creditors, demutualize[4] or sell to investor-owned companies. For example, Agrifoods International Ltd. (Dairyworld), Canada's second largest dairy co-operative and Western Canada's largest food manufacturer, took on large levels of debt and was ultimately sold to the Montreal-based food conglomerate Saputo Inc (a private company) in 2001 (Canadian Dairy Information Center, 2002). Over the period during which it operated, Agrifoods International Co-operative Ltd. showed a significant dependence on debt financing. As evident from Figure 1-2, Agrifoods' debt to equity ratio was moving strongly upward in the latter part of the 1990's, to a value of approximately 5 in 1999 (Agrifoods International Co-operative Ltd, 1999). Anecdotal evidence suggests that Agrifoods' debts were nearly equal to its selling price on sale.

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[2] Debt-to-Equity Ratio is a company's total liability expressed as a percentage of members' equity. The Debt/Equity ratio (D/E) measures the proportion of risk supported by creditors as compared to investors (members); a larger ratio indicates higher risks as the majority of the assets are financed with debt, while a ratio smaller than 1 indicates that equity finances the majority of assets. Theoretically, there is no upper limit but any business with too much leveraged capital certainly runs the risk of 'loss.' The desired value of the ratio will depend on business type and the resulting income variability of the business as well as other factors, such as the risk associated with production and prices. Businesses with high-income variability may want to achieve a lower ratio.

[3] The growth rate is estimated using the equation: $(\text{Equity}) = \alpha e^{\beta^{*}\text{time}} + \text{error}$.

Lilydale Foods Inc. is another example, having increased its debt to equity ratio from 1.17 in 1990 to 2.23 in 2000, indicating an increasing dependence on debt financing for investment (Figure 1-2). Over the period 1972-2001, equity capital for Lilydale Foods Inc. has been increasing at an annual rate of approximately 9 per cent. During the period 1990-2002, the Saskatchewan Wheat Pool had debt-equity ratios above 1.0, with the exception of the years 1992 and 1999, suggesting a need to reduce its debt load. The debt burden is largely because of the elevator construction race across the prairies.

> *The Saskatchewan Wheat Pool (SWP) was sliding toward an inexorable debt crisis. Only through a fire sale of assets was it able to meet debt-repayment obligations in fall of 2002* (Byfield, 2002).

The SWP currently faces considerable financial and organizational challenges (Fulton and Giannakas, 2001).

The bottom line is that the few co-operatives (e.g., Agrifoods International Co-operative Ltd, Alberta Wheat Elevator, and Manitoba Pool Elevators, United Farmers of Alberta, Saskatchewan Wheat Pool, Lilydale Foods Inc.) that make up the largest part of total revenues of agricultural marketing co-operatives have been characterized by capital constraints and are seeking alternative ways of raising capital. Capitalization issues have heavily affected the co-operative sector, particularly the grain and dairy industries, and as a result, there has been consolidation, demutualization, heavy indebtedness, and takeover by private companies in these sectors.

> *However, given the significant economic and social activity that agri co-ops generate in Canada, potential exists for co-ops to successfully implement changes to address their capitalization needs. Opportunities exist for Canadian agri co-ops to exploit alternative capitalization models currently being used in other countries; strengthen corporate governance structures to attract and gain confidence of outside investors and lenders; and pursue stronger alliances with agri co-ops and financial co-ops.* (Ernst and Young, 2002:7)

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[4] Demutualization is the process through which a member-owned company becomes shareholder-owned. Frequently this is a step toward the initial public offering (IPO) of a company. Demutualization is usually done in order to raise additional capital.

1.2 Formation of Co-operatives: Why Co-operatives?

Co-operatives play a major role in the agriculture and food industry of Canada. Co-operatives have existed for more than a century in the Canadian agriculture sector. They are considered to be a separate form of business organization, extending the conventional classification of single proprietorships, partnerships, and investor-owned firms (IOFs). Co-operatives have separate legislation governing their creation and have different tax provisions. Historically, the formation of agricultural co-operatives stemmed from economic concerns associated with market failures resulting from an unequal distribution of economic power[5]. These concerns related to lack of market access for various groups of farmers, negatively affecting their welfare (Cook, 1995; Fulton and Hammond Ketilson, 1992; Hansmann, 1988; Vitaliano, 1983; LeVay, 1983). Thus, groups of farmers acting together in co-operatives have been able to gain much of the economic power associated with size. For example, the United Farmers of Alberta was formed to promote the interests of farmers and ranchers, by uniting their efforts to obtain fair prices for farm produce and the cheapest prices for transporting that produce to market (Heritage Community Foundation, 2002). Market failure, resulting from incomplete and asymmetric information (i.e., unequal distribution of information[6]), in the supplier-farmer or farmer-processor relationship (Hansmann, 1988) resulting in market transaction costs (Hendrikse and Bijman, 2002) is another reason for the formation of co-operatives.

In Hansmann's terminology, when farmers do not own the firm, they incur market transaction or contracting costs. Market contracting costs may include costs associated with differences in market power as in the case when customers face a monopoly, or costs associated with learning about and negotiating the terms of trade, or the cost of searching for product quality information. In the case of market power, patron ownership may help members to realize a significant saving of market transaction costs by setting a price that is lower than the monopoly-pricing outcome. Assigning ownership to the patrons involved in the business of the organization helps to mitigate the costs of market contracting by avoiding the inefficiency that results from setting prices above marginal costs; and by reducing the incentive for the firm to exploit asymmetric information (Hansmann, 1988).

However, the downside with the patron-owned organization may be the associated costs of ownership, including failure to exercise effective control over the management of the firm – ownership costs (Hansmann, 1988) or agency costs (Jensen and Meckling, 1976). There are three categories of ownership costs (Hansmann 1988): controlling managers, collective decision-making, and risk-bearing. Costs of controlling managers (i.e., monitoring costs and managerial opportunism) and collective decision-making (i.e., costs of inefficient decision, and time and effort required for owners to meet and to reach decisions) arise from owners' formal rights to control the firm. Cost of risk-bearing is associated with the owners' rights to the residual earnings. In a worker-owned and managed firm, for example, their motivation and self-monitoring significantly reduces the ownership costs of contracting the labour process. From the above, it can be claimed that the overall motivation for the formation of the user-owned organization is to minimize the sum of the costs of market contracting and the costs of ownership (Hansmann, 1988). As Hansmann (1988:281) puts it:

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[5] For example, in a single firm industry, when a monopoly firm charges a single price, the price exceeds marginal cost.

[6] For example, the ingredients and quality of commercial animal feeds and chemical fertilizers are largely unknown to farmers and subsequently farmers may have less trust in the products from investor-owned firms. This imbalance in information may arise because it is relatively costly for farmers to obtain information. In the past, this might have resulted in the formation of some of the farmer-owned agricultural supply co-operatives.

> *Any assignment of ownership involves important trade-offs between the costs of market contracting and the costs of ownership. The efficient assignment is that which minimizes the sum of such costs among all the patrons of the firm.*

Thus, Hansmann's market-contracting-cost and ownership-cost minimization criterion can be used to explain the prevalence of various ownership patterns. For example, Hansmann (1988: 284) explains the low market share of customer co-operatives as follows:

> *... customer co-operatives have an almost negligible share of the market for nearly all ordinary retail items... The small market share held by retail co-operatives is understandable in terms of the [market-contracting-cost and ownership-cost].... The costs of ownership for many consumer goods and services are high.... And for those goods which the costs of customer ownership might be manageable - ....for items that comprise a significant share of consumer budgets – the costs of contracting are typically low: retail markets for such items are sufficiently competitive to keep prices close to cost,... that asymmetric information about quality is not a serious problem.*

Based on the above analysis, the pattern of prevalence of co-operatives in Canada may be due to sector or industry specific pattern in high market-contracting costs arising from market power, asymmetric information, and lack of availability of services at a local community level. For example, in 1999, the co-operatives were particularly significant in processing and marketing dairy products (53 per cent of the market), poultry and eggs (53 per cent of the market), grains and oils seeds (49 per cent of the market in the west), honey and maple (21 per cent of the market), fertilizer and chemical (40 per cent of the market in 2000), and farm petroleum (32 per cent of the market in 2000) (**Table 1-2**). In these markets, there is room for only a few important buyers/processors of farm outputs or only a few sellers of farm inputs because of substantial economies of scale in having a few firms with a degree of market power to serve the independent farmer patrons in a given geographical region. As a result, there is an incentive for farmers to avoid price exploitation by owning the firm that serves them; and mitigate costs of market contracting resulting from market power and information asymmetry. As the patrons "own" a significant proportion of these businesses, costs of ownership are highly favourable to farmer-owned supply and marketing co-operatives.

Over the past few years, the co-operative sector has seen a drop in its market share. This period of decline in market share coincides with the time period during which many co-operatives struggled with generating adequate capital. For example, inadequacy of capital has been a factor in some grain co-operatives who have been entering strategic alliances with investor owned firms for marketing members' grains (e.g., United Grain Growers with ADM (Archer Daniel Midland Company)). In 2001, the estimated market share of agricultural co-operatives ranged between 8 per cent (for seeds and fruit and vegetables) to 49 per cent (for poultry and eggs) (**Table 1-2**). As presented in **Table 1-2**, agricultural co-operatives' overall market share is lower in 2001 as compared to 1995, with the most significant decline being in grains and oilseeds (with the sale of Agricore to United Grain Growers in 2001), dairy (with the sale of Dairyworld to Saputo Inc. in 2001), and fruit and vegetable co-operatives. For example, until 2001, the most dominant organizations in the dairy processing industry were producer-owned co-operatives, which accounted for more that 60 per cent of the industry's output (**Table 1-2**).

This may suggest that when co-operatives are faced with tight operating margins and capital constraints, the traditional co-operative structure may not be a low-cost ownership alternative. As a result, both farmers and consumers may be facing the possibility of market failure on a global scale because of the increasing concentration of food processing and marketing in the hands of a few transnational corporations. However, this may present opportunities that co-operatives, by the very nature of their organizational structure and history, will be distinctively qualified to fill (Seipel and Heffernan, 1997).

In summary, market power held by one class of patrons can cause another class of patrons to incur considerable market contracting costs. Imperfect competition in the output market, for example, imposes significant market transaction costs on consumers unless they are also the owners. On the other hand, if a firm has substantially better information about its performance and/or output, the imbalance in information can result in significant contracting costs for its patrons. Thus, patron-owned businesses could confront lower market contracting and ownership costs, than would investor-owned businesses.

1.3 An Overview of the Theory of Co-operatives

A co-operative is a business organization that is owned and controlled by users of its products, supplies or services for their mutual benefit. As co-operatives are multifaceted business organizations that undertake a wide variety of functions, there is no single behavioural economic objective, such as profit maximization, that is generally accepted by all managers, boards of directors, members, and co-operative academics. This raises interesting issues and challenges related to the appropriate behavioural framework for use in the economic modeling of co-operative firms. From previous evidence, some of the following are stated as the objectives of co-operative by various scholars: maximization of members' welfare[7] (Bateman et al., 1979; Enke, 1945; Taylor, 1971), profit maximization of the co-operative firm, joint profit maximization, growth of membership, output maximization, maximization of patronage refunds per unit, maximization of net returns per unit for marketing co-operatives (Bateman et al., 1979; Ladd, 1982; Sexton, 1984), maximization of producer surplus for marketing co-operatives and maximization of consumer surplus for supply co-operatives (Bateman et al., 1979; Nerlove and Waugh, 1961), raw product price maximization for whatever quantity producers choose to supply by marketing co-operative members and minimization of input price for supply co-operative members (Helmberger and Hoos, 1962). Brief discussions for these alternative behavioural objectives of co-operative firms are provided next.

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[7] Maximization of member welfare is defined as the sum of co-operative profit and producer surplus for marketing co-operatives, and as the sum of co-operative profits and consumer surplus for supply co-operatives.

1.3.1 Theory of the Firm and Marketing Co-operatives

Agribusiness marketing co-operatives are user-owned and user-controlled business organizations that assist members in maximizing returns from goods produced. Agribusiness marketing co-operatives handle, process, sell, grade, transport, bargain, add value, and research new product development.

Maximization of Members' Welfare

For marketing co-operatives, the members' welfare maximization objective is achieved when the sum of co-operative profits and producer surplus is maximized (Taylor, 1971; Enke, 1945) subject to the break-even condition. In the co-operative literature, this objective is sometimes referred to as joint profit maximization (i.e., the sum of profits made by the member-patrons in producing the raw input and the profits from the co-operative processing or value added plants) (Bateman et al., 1979). In Figure 1-3, the welfare maximization objective is achieved when the marginal value product (MVP) equals the input supply (SS) – this result is equivalent to the competitive industry equilibrium suggesting that maximization of the co-operative members' welfare implies maximization of the welfare of society at large [point D Figure 1-3]. In this case producer surplus equals the triangle W_0W_4D. DG is the per unit co-operative profit that may be retained for future growth or distributed to its members as patronage dividends (i.e., the area $MGDW_4$); that is, the difference between net average revenue product (NARP) and the supply curve. It is the first best solution because it maximizes members welfare for a given raw product supply curve.

Marginal cost pricing is frequently used when the objective is to maximize the economic welfare of the members. However, marginal cost pricing often fails to generate revenues which satisfy a break-even constraint. If marginal cost is less than (exceeds) average cost, marginal cost pricing generates a loss (surplus). In reality, losses can arise for a co-operative firm with declining average total costs (and consequently falling marginal costs) as prices, if set to equal marginal cost, fail to cover fixed costs. This might be the case for marketing co-operatives involved in significant investments in plants and equipment for processing their members' output. This suggests that there are high fixed costs for plants and infrastructure. When a co-operative fails to cover its fixed costs, the welfare maximization behavioural objective is constrained to satisfy the break-even condition. Otherwise, the co-operative may not survive in the long-run. This analysis suggests that the knowledge of the cost structure of the co-operative is important to understand its actual objective. Co-operative theorists commonly avoid this problem by assuming that a co-operative employs an average cost pricing policy, thus, satisfying the Ramsey second-best optimum in the single-product case (Sexton, 1986). Based on Figure 1-3, the problem with this optimization solution is that, in general, NARP≠MVP, implying that the co-operative's break-even requirement generally cannot be met by a single price. If MVP is less (greater) that NARP and members are paid a single price equal to MVP, the co-operative will have a deficit (surplus). Thus, to preserve the optimum and to meet the break-even requirement as well, the co-operative should turn to multi-part pricing schemes or restrictions of members' supply (Sexton 1986).

Maximization of Co-operative Profit

In a single firm industry, a profit maximization objective is equivalent to the monopsonist solution, or that of an investor owned firm (IOF). The output associated with the profit maximizing co-operative is determined by the intersection of the marginal expenditure/outlay (MO) of buying farm products by the co-operative from the member-patrons and the MVP of the input purchased by the co-operative from its members [point F in Figure 1-3]. In Figure 1-3, X_3 is the amount of inputs purchased from member-patrons by the profit maximizing firm. In this case w_3 is the price member-patrons receive per unit of the input supplied to their co-operative and CH (>DG) is the per unit retained earning or patronage dividend to be distributed to members. Producer surplus amounts to W_0W_3C. In the case of the profit maximizing co-operative, although the total retained earnings or patronage payments are at their maximum, the total welfare of the members (low price for their products) and society is not at its maximum. The net welfare loss to the society amounts to the triangle CDF. The producer surplus lost due to the reduction in the level of inputs purchased by the co-operative and the associated decrease in price amounts to W_3W_4DC. However, as opposed to a profit maximizing monopsonist IOF, the member-patrons will receive some or all of the profits generated by their co-operative as patronage dividend. In general, this outcome may not be the optimal solution for members as the loss in producers' surplus is higher than the gain in profits.

Optimizing Membership

The behavioural objectives of co-operative firms mentioned above are based on the assumption that the number of co-operative members is fixed. But, if the number of members can be varied in the co-operative, the question is then what would the optimal number of members be from the perspective of the members that were remaining in the co-operative (Fulton 2001)? For marketing co-operatives, since the position of the supply curve, in part, depends on the number of members, the optimization with respect to the membership size occurs where supply is constrained to intersect the maximum NARP (at point K), giving members the maximum raw product price possible (Clark 1952; Sexton et al., 1989). This objective requires that members be identical. If the supply curve intersects the NARP curve to the left of the maximum, there are too few members in the co-operative. The incumbent members would benefit from additional membership. On the other hand, if the supply curve intersects the NARP curve to the right of its maximum, there there are too many members in the co-operative. In such a case the co-operative, has expanded processing too far and is suffering from diseconomies of scale. This case poses the question of who should leave the co-operative and who should stay? If there are benefits to having a smaller co-operative, everyone would be interested in obtaining these benefits. Ideally, members who are in a co-operative that is too large will have an incentive to leave and enter or form a new co-operative, thereby reducing the size of the existing co-operative. If some of the members were to leave the co-operative, the welfare of the remaining members would be improved. For the members of a small co-operative, there will be no incentive for everyone to leave.

With open membership, since the position of supply curve depends on the number of members, the optimal number of members in the co-operative is that which shifts the demand curve so that it cuts NARP at its maximum (Point K, Figure 1-3). However, this strategy violates the principle of open membership adopted by co-operatives internationally. Note that the above analysis assumes that all members supplied the same amount and/or they all have identical cost curves and it requires that members be identical. When members are heterogeneous, optimal size cannot be defined independently of the "core" (Pauly 1967; 1970; Sexton, 1986).

Growth of Membership/Adjustment

A related but very different concept is growth of membership (Bateman et al., 1979). According to LeVay (1983) the growth of membership is not a matter of a deliberate strategy to maximize anything, but occurs because co-operatives allow free entry to anyone with eligible produce. Under an open-membership policy, a co-operative accepts any eligible producer who applies for membership. Thus, based on the principle of open-membership, the co-operative welcomes all eligible raw products being offered so long as it result in no loss to membership. As a consequence, it may not be able to maintain its membership in order to set the quantity that may result in the greatest raw product price. This policy leads to SS=NARP if all members are treated alike, which is similar to the outcome achieved by maximizing output. This analysis assumes an aggregate supply curve for both incumbent members and potential entrants. Since the incumbent members would lose in relation to the potential entrants as membership expands beyond the point of welfare maximization (point D, Figure 1-3), it is difficult to imagine the practicability of such a policy. Under this policy, the quantity supplied and membership would move together if all members supplied the same amount or if they all had identical cost curve (Bateman et al., 1979).

Note that the position of the supply curve depends on the individual members' behavioural objective at the farm level. Under an identical cost curve assumption, if the price they receive from the co-operative is higher than the average cost at the farm level, there will be an incentive for potential entrants to join the co-operative and supply more, since they will benefit from the higher price that can be achieved by such a move. Such a strategy shifts the supply curve outward, reducing price received and increasing the quantity supplied and processed. When such output expansion is based on new members, earnings diminish to the incumbent members. On the other hand, if the farmers are paid less for a given volume of their product than indicated by the average cost at the farm level, there will be an incentive for the existing members to exit the co-operative. Again, this raises a fundamental question about who should leave the co-operative and who should stay? The action of the existing members shifts the supply curve to the left till the point where the average costs of production at the farm level are equal to the price received from the co-operative.

> *Growth in membership would be a possible objective if there were a belief among the leadership if co-operative principles, particularly that of open membership, which could be construed in terms admitting as many providers of the raw product as possible.* (Bateman 1979: p.69).

Practically, growth in membership may be driven by cost-price deviations. The potential members judge the desirability of entry on the basis of incumbent co-operatives' prevailing price (Sexton, 1986) and average cost at the farm level. That is, growth in membership depends, among other things, on the cost-price deviation; hence the growth in membership is the outcome of opportunistic members' actions rather than an objective being pursued by the co-operative per se.

> *A prominent example is defecting to other marketing outlets during tighter-supply, higher-price years...the apparent reason is well known: a [co-operative] is a prisoner's dilemma – the [incumbent] members [and new entrants] collectively benefits from cooperation but individually have incentives to cheat.* (Sexton, 1986: 1168).

New members will enter the co-operative if the pricing is favourable to them; and existing members will exit the co-operative if the pricing is unfavourable to them. The positive price-cost deviations imply a profitable entry opportunity for non-members. Note that with non-increasing average costs curve expansion of membership could benefit the existing members from exploiting scale economies. However, a non-increasing average cost does not preclude that adding members to a co-operative will raise marginal costs and reduce benefits to the existing members (Sexton, 1986).

Maximization of Patronage Refunds per unit

Assuming an upward sloping input supply curve, this objective can be achieved at the point of tangency for a line drawn parallel to the supply curve (SS) with the NARP curve [point J, Figure 1-3]- which is to the left of the maximum of NARP. In this case, input purchase and its price will be set at X_1 and w_1, respectively. Members will receive a per unit patronage payment of AJ. However, restricting output to X_1 is against the open membership co-operative principle. The other concern with this objective is the underutilization of plant capacity, resulting in higher per unit costs.

Maximization of Net Returns per unit

The maximization of net return per unit, also referred to as maximization of price, is achieved if output is set at X_2, where MVP crosses NARP [point I , Figure 1-3]. At point I, although the price received by members is very high, member welfare is not maximized by adopting this objective. Members will be better off by increasing output to X_4 where SS equals to MVP. At point I the marginal benefits of additional X is clearly higher than its marginal costs. Under open membership, pursuing this objective may also result in oversupply of inputs by members (i.e., X_{max}). Thus, it requires the co-operative to restrict its membership or member production so as to constrain its members' supply to intersect the maximum NARP, providing members the maximum price possible for their raw products (Clark 1952; Sexton 1995).

Maximization of Output

Subject to the constraint that profits are earned (or subject to the break-even condition), output maximization would be a reasonable objective for a marketing co-operative (Bateman et al., 1979). Specifically, if the manager may judge the success of the co-operative on the basis of maximizing output, or if salaries are related to output, as is the case with membership maximization, maximization of output may be pursued. This objective is achieved at the intersection of SS and NARP [Point E, Figure 1-3]. That is, the quantity of raw product processed by the co-operative is maximized at level X_5. In this case the co-operative pays the maximum price for the given amount of raw product delivered, subject to covering processing costs. This solution satisfies the break-even constraint of co-operatives but, in general, does not maximize member welfare. (Helmberger and Hoss, 1962) Generally, this is not an optimal solution.

Beyond point E there might be excess supply of farm inputs and co-operative outputs, yet the co-operative will not expand production if to do so would reduce income of its members. The maximization of output produces the only stable solution for the price. It should be noted that the position of the co-operative supply curve depends on the individual members' behavioural objective at the farm level. If the price they receive from the co-operative is higher than their farm level average cost of production, there will be an incentive for some members to supply more, since they will benefit from the higher price that can be achieved by such a move. However, when such output expansion is based on new members, it diminishes earnings to the original or current membership. On the other hand, if the price they receive from the co-operative is lower than the average cost of production at the farm level, there will be an incentive for some members to cut back their supply, since they will benefit from the higher price that can be achieved from such a move. The supply of raw material to the processing co-operative will increase until it reaches the level X_5 (i.e., the point where the average cost of production at the farm level is equal to the price received from the co-operative). Yet, the raw material supply may not easily be adjusted in the short-run, especially when membership reduction is considered.

The above analysis assumes that in the short run membership of the co-operative is fixed but raw material supplied per member can be varied, whereas in a planning period longer than the short run it is assumed that membership can be varied with the proviso that there are no involuntary expulsions (Ireland and Law, 1981). Under a Cournot equilibrium, each producer decides on his/her raw material quantity, using the assumption that other members will not make any change to their raw material input supply in response to that decision (Ireland and Law 1981). In the extreme case, some members may decide to exit from the co-operative if the pricing is not favourable to them. In sum, the output maximization objective might be the outcome of the members' behavioural response to pricing at the co-operative level; and hence it is guided by the action of the individual members. In other words, co-operative level production decisions rest with individual producers responding to market price signals. Profits earned at the farm level affect members' behaviour and the outcome at the co-operative level. If management wants to expand a co-operative's production in a situation of decreasing returns, their action would result in potential conflicts of interest.

Then, what do co-operative firms actually maximize? The principal conclusion from the above review of possible co-operative objectives is that any attempt to explain/define the actual behavioural objective of a co-operative firm as a solution to a maximization problem is complex and likely to encounter several difficulties. This raises a more fundamental question concerning the formulation of the co-operative objective function. As previously mentioned, there is no agreement as to the particular objective that is used by co-operatives; observed co-operative behaviour would suggest that there are a number of potential candidates. In particular, it is not clear that the appropriate objective function exists, and if in fact it does exist, that it is identifiable and quantifiable (Zusman 1982). Each solution may be appropriate for given circumstances, and, therefore it is an important empirical issue rather than a normative one.

According to Zusman (1982), the basic policy decisions in a co-operative are group choices, and whenever members are not identical, it is even doubtful that a unique co-operative objective actually exists. In addition to members' group choices, managers' and directors' actions influence the actual or perceived objective/outcome at the co-operative level. Thus, from the actual co-operative firm behaviour perspective, it is not obvious which objective(s) is(are) being pursued and therefore this is open for empirical investigation.

If the co-operative acts to maximize the welfare of its members, the result would be an increase in the well-being of the members and society (Enke 1945; Taylor, 1971; Helmberger, 1964). The welfare-maximizing solution has been described as reconciling a member's conflicting role as an owner and a patron, as it balances the profit motive with the desire to conduct business on the most favourable terms possible (Sexton, 1984). The general belief seems to be that the presence of co-operatives in the market has positive welfare effects by forcing a market towards the competitive outcome. A substantial body of literature by agricultural economists also support this view. For example, Staatz (1987) suggests that there is valid justification for public policy support of farmers' co-operatives, particularly because of their effects with respect to competition and their potential to improve economic coordination. Fulton's (1989) theoretical work seems to reinforce this claim. Fulton (1989:15) found that

> *the entrance of a co-operative into an oligopolistic industry can be expected to improve the efficiency of the industry. In particular, if the industry has a cost structure similar to that found in the fertilizer industry, the existence of a co-operative interested in maximizing member welfare will drive the price down to the competitive level.*

If that is the case, the welfare maximization objective may better represent the long-term objective of the co-operative associations. In Figure 1-3, the most appealing feature of setting output at D lies in its conformity with Pareto optimality as the supply price of the input is equal to MVP at D. As compared to the Pareto optimality point, the above alternative co-operative firm behavioural objectives involve a trade-off between the producer surplus earned by the members and the profits obtained by the co-operative. If members are interested in both the producer surplus and the profits of the co-operative, the maximum total welfare will be obtained at point D, where MVP intersects SS. Theoretically, any deviation from point D will make the total welfare of the members "worse". Under welfare maximization behaviour, the marketing co-operative[8] markets the amount of farm inputs or raw materials that lead to the greatest total returns to its members (Bateman et al., 1979). This objective may be particularly reasonable for members whose decisions to sell farm output are based on the maximization of total profits including patronage refunds. Price-taking co-operative agribusiness firms facing a given production technology choose their input demands and output supplies so as to maximize their members' welfare. The welfare maximizing behaviour of the marketing co-operative firms is outlined for exposition purposes. For marketing co-operatives, the producers' welfare may be defined as:

$$MW = \pi^c + PS \qquad (1\text{-}1)$$

where MW is producers' welfare, π^c is co-operative firm's profit and PS is producer surplus defined as:

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[8] Marketing co-operatives are co-operatives that market the farm commodities produced by member producers. Sometimes marketing co-operatives buy farm commodities from their members to undertake processing of the farm commodities to add values.

$$\pi^c = Py - P_0M_0 - \sum_{i=1}^{n} P_iX_i - K \qquad (1\text{-}2)$$

$$PS = P_0M_0 - \int_0^{M_0} P(M)dm \qquad (1\text{-}3)$$

where P is the price of co-operative's output, y is the quantity of co-operative output, P_0 is the price of raw materials from members, M_0 is the quantity of raw material from members, P_i is a vector of prices for other variable inputs, X_i is a vector of quantities of other variable inputs and K is the fixed cost. Substituting equations (1-2) and (1-3) into (1-1) gives:

$$MW = Py - \int_0^{M_0} P(M)dm - \sum_{i-1}^{n} P_iX_i - K \qquad (1\text{-}4)$$

The integral $\int_0^{M_0} P(M)dm$ can be interpreted as the variable costs of producing M_0. Assuming that the capital input is quasi-fixed in the short-run, the maximum welfare function for the co-operative may be given as:

$$MW^s = W(P,P_0,P_i,k) \qquad (1\text{-}5)$$

where MW^s is a short-run producer welfare function, and k is a short-run quasi-fixed capital stock. Assuming that the level of the co-operative's output is given, the welfare maximization problem is equivalent to minimizing the short-run total cost function:

$$SVC = C(y,P_0,P_i,k) \qquad (1\text{-}6)$$

1.3.2 Theory of the Firm and Supply Co-operatives

Agribusiness supply co-operatives are user-owned and controlled business associations that allow members to gain access to affordable farm inputs and goods. Supply co-operatives purchase inputs in bulk to reduce costs and increase purchasing power and provide direct ownership of refineries, plants, retail facilities and research facilities. As in the case for marketing co-operatives, several behavioural optimization problems have been suggested in the supply o-operative literature. Some of these optimization problems are briefly presented below.

Maximization of Member Welfare

One of the behavioural assumptions for supply co-operatives is the maximization of the sum of co-operative profits and members' consumer surplus. In a single firm industry where a co-operative is the only firm supplying inputs to its members, this objective is obtained at the point where supply (i.e, MC, or marginal cost) and demand (DD) are equal [point D, Figure 1-4]. At point D, the output produced by the co-operative is Y_4 and the price charged to the members is P_4. From both a societal and co-operative membership perspective, point D is a Pareto-efficient solution. Consumer surplus is equal to the triangle P_4DP_{max} while the per unit patronage payment is ID.

Maximization of Co-operative Profit

If the co-operative is behaving as a profit maximizing monopolist firm, the price that the co-operative charges is determined by the interaction of marginal cost (MC) and marginal revenue (MR) [point C, Figure 1-4]. In this case, the co-operative produces Y_3

units of output and charges a price of P_3. It can be shown that the amount of profit gained by pursuing this objective is lower than the amount of consumer surplus lost by the members of the co-operative. Welfare loss to the society is equivalent to the triangle CDF. In this case, the per unit profit increases to JF and the consumer surplus goes down to P_3FP_{max}.

Maximization of Output

The output maximization objective would be achieved by equating average costs (AC) to average revenue or the demand curve (DD). In this situation, members will not receive any patronage payments. Members are better off if output is reduced to the point where supply is equal to demand. It can be shown that the same quantitative results will be obtained in the case of average cost pricing. If co-operative firms follow this objective, they will overproduce relative to the welfare optimization solution. The loss in profits is greater than the gain in consumer surplus when the objective of the co-operative is to maximize output as opposed to welfare maximization. The patronage payment is zero while the consumer surplus is P_4EP_{max}.

Maximization of Patronage Payment

Maximization of patronage payment is obtained when the vertical distance between average costs of production and average revenue is maximized. In Figure 1-4 this is equivalent to producing output Y_1 at price P_1. The implication of this objective is the same as that for marketing co-operatives. In this case, patronage per unit is equal to AH while the consumer surplus is P_1HP_{max}. The loss in consumer surplus is greater than the gains in co-operative profits.

Minimization of Net Price per unit (Minimum Cost Pricing)

According to the Rochdale at cost principle, member-patrons, as purchasers of co-operative outputs, want to obtain services at the lowest possible price. If this objective were adopted by the supply co-operative, it would result in production at the point where marginal cost intersects the average costs of production leading to excess demand [point B, Figure 1-4]. Members would demand Y_{max} if the product is priced at P_{min}. If the objective of the co-operatives is to maximize overall members' benefits, pursuing this goal may not maximize their benefits.

In general, if the long-run objective of the co-operative firm is to maximize its members' benefits, it may be necessary to consider the welfare maximization problem as the behavioural objective of the co-operative firm. As is the case with marketing co-operatives, any attempt to explain the actual behavioural objective of a co-operative firm as a solution to maximization problem is complex and likely to encounter several difficulties. There are no agreements as to the particular objective that is used by co-operatives. For explanation purpose, in the following research the welfare optimization problem is assumed for supply co-operatives. However, as opposed to the marketing co-operative, the objective of the supply co-operative[9] is defined as the optimization of the sum of co-operative profits and consumer surplus:

$$MW = \pi^C + CS. \tag{1-7}$$

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[9] Supply co-operatives are co-operatives that supply their members with farm inputs or other goods and services, sometimes they are called retail co-operatives.

where MW is the gross benefit members get from purchasing and using x_j^0, π^C is the profits of co-operative firm and CS is consumer surplus. Consumer surpluses are fixed if the price of x_j^0 is fixed and the co-operative can maximize members' welfare only through maximizing profits. The co-operative's profit (π^C) and the consumer surplus (CS) are defined as $\pi^C = \sum_{j=1}^{k} w_j^0 x_j^0 - C(.) - K$ and $CS = \int_0^{x_j} w(x)dx - \sum_{j=1}^{k} w_j^0 x_j^0$, respectively.

Substituting the expressions for π^C and CS gives:

$$MW = \int_0^{x_j} w(x)dx - C(.) - K \tag{1-8}$$

where $\int_0^{x_j} w(x)dx$ is gross revenue from selling products to the members.

The maximum welfare function for a retailing co-operative may be defined as in equation (1-8) above. The short-run cost functions may also be defined in the same way as in equation (1-6).

1.3.3 Measures of Output for Agribusiness Co-operative Firms

One of the issues that has received special attention in the co-operative literature is the choice variable to use as a measure of output for those firms providing services to patrons and for those firms adding value to the outputs of their patrons. Specifically, one of the challenges in estimating cost functions for a supply co-operative is that the direct measure of output (service), y, is difficult if not impossible to quantify accurately. Various measures of retail/wholesale output have been assumed by different studies; among others, constant dollar sales – proportional to service provided (George and Ward, 1973; Ingene, 1982; Donthu and Yoo, 1998; Messinger and Narasimhan, 1997); constant dollar sales weighted by gross margin (Schwartzman, 1971); constant dollar sales weighted by labour cost (Carey and Otto, 1977; Marke, 1982); and constant dollar value added (Waldorf, 1966). Other behavioural output measures include service quality (Parasuraman et al., 1994); customer store loyalty, customer and employee satisfaction (Lusch and Serpkenci, 1990; Donthu and Yoo, 1998); number of services (Messinger and Narasimhan, 1997). For the purpose of the present study, data for some of these measures (e.g., customer store loyalty, customer satisfaction and service quality) are practically impossible to obtain over extended time series. Thus, the service provided by the retailing co-operative is surrogated by constant dollar value added. The total output or service of supply co-operative is assumed to be proportional to constant dollar value added. This assumes that the prices of retail service vary in strict proportion over time (Ratchford and Brown, 1985). Thus, for a supply co-operative the gross output production function can be defined as:

$$y_t = f(V_t, M_t) \tag{1-9}$$

where y_t is gross output (gross sales), V_t is real value added as a measure of service, M_t is the value of items which are purchased at wholesale and sold in the store at time t. Thus, the value added is calculated as the difference between sales and costs of goods sold (COGS), (i.e., $V_t = y_t - M_t$). Hence, the value-added production function is given as:

$$V_t = g(k_t, L_t, I_t) \tag{1-10}$$

where k_t is short-run quasi-fixed capital input, L_t is labour input and I_t is other intermediate inputs (e.g., utilities, insurance, promotion, other purchased services, etc.). Substituting [1-10] in [1-9] yields:

$$y_t = f(g(k_t, L_t, I_t), M_t) \qquad (1\text{-}11)$$

Since the output is a measure of the service provided by supply co-operative, it is more logical to use the real value added as a measure of output. Using Shepherd's Lemma, the dual of the real value added production function can be defined in terms of cost function as follows:

$$C = C(V_t, w_L, w_I, k_t, t) \qquad (1\text{-}12)$$

where C is the sum of actual capital, labour and intermediate inputs costs deflated by implicit GDP deflator or costs of value added or costs net of payments for the items sold at retail and C(.) is the optimal level of costs of value added, w_L is wage rate and w_I is price of other inputs. The concept of value-added production function is equally applicable to agricultural marketing co-operatives that are involved in value adding activities.

1.4 Capital Constraints in Agribusiness Co-operatives

In corporate finance, a major concern is with the method of financing firms so as to ensure their survival and growth (Modigliani and Miller, 1958). In the process of managing co-operative finances, the BODs and managers frequently face challenges in connection with the appropriate capital structure and the issues around external and internal sources of finance that match with the values of the co-operative business.

For co-operative firms, the financing of capital investment is a somewhat different issue than for IOFs. Co-operative agribusiness firms face more difficulties in raising the capital necessary to finance capital investments because of capital constraints/structure (Doyon, 2001). Chaddad (2001) provides a list of factors that may create equity capital constraints in co-operatives. Chaddad (2001) explained the fact that traditional co-operative agribusinesses have capital constraints on the basis of the following arguments: (i) co-operative residual claims are restricted; (ii) co-operative members do not have appropriate incentives to invest; (iii) equity capital acquisition in traditional co-operatives is tied to member patronage; (iv) co-operative equity capital is not permanent; and (v) co-operatives have limited access to external sources of funds. Since co-operative firms have no capital resources of their own, the mobilization of external financial resources such as from member contributions/shares, banks, related firms (venture capital, strategic alliances), co-operative joint-stock companies, or foreign firms are possible sources. However, if the organization wishes to remain a co-operative not all of these external financial sources are feasible. Although Chaddad's (2001) empirical findings tend to suggest that agricultural co-operatives are financially constrained, not all co-operatives, however, appear to face capital constraints when they make their capital investment decisions. For example, large co-operatives, co-operatives with low amounts of permanent equity capital and co-operatives with high credit risk are more financially constrained than small co-operatives, permanent equity capital co-operatives and low credit risk co-operatives (Chaddad, 2001).

A challenge associated with the use of member capital for self-financing is the fact that the active members may have limited financial capacity and may be reluctant to invest further in their co-operatives (Chaddad, 2001). Members may be unwilling to increase their illiquid equity stake in the co-operative, because of the non-marketability of co-operative equity capital (Chaddad, 2001). Members may also be unwilling to allow the co-operative to increase its equity base through retained earnings, because retention of earnings translates into lower effective prices for products marketed through the co-operative or higher effective costs in the case of farm inputs purchased through a co-operative (Lerman and Parliament, 1992). Put differently, for marketing co-operatives, members' benefits are in terms of higher prices for their product and the annual patronage payment[10]. In this case, if the members are not getting the patronage payment at the end of the year due to retained earning this may translate into lower effective prices for the members' products. For supply co-operatives, members' benefits come from lower prices for the input they purchase and the patronage payment at the end of the fiscal year. Thus, if the patronage is not distributed at the end of the year and diverted to investing activities (or retained earnings), this may translate into higher effective prices for the inputs purchased from the supply co-operatives. The above equity capital constraint has forced co-operative firms to introduce "allocated patronage refunds" to be paid out in cash with a lag of several years. However, this approach as well cannot replace raising external equity capital through issuing new shares.

The situation is further complicated by the changing structure of co-operative membership, such as the ageing and retirement of existing members. Factors such as the absence of a secondary market for equity capital, property right allocations (Vitaliano, 1983; LeVay, 1983; Knoeber and Baumer, 1983; Cook, 1995; Chaddad, 2001), and the high opportunity costs of money (Junge and Ginder, 1986) for co-operative members are other contributors to the problem of capital constraints. In addition, co-operatives experience specific agency problems related to (i) the horizon problem, (ii) the common ownership problem (or the free-rider problem), (iii) the portfolio problem, (iv) the decision-making problem (or the influence costs problem, and v) the follow-up or control problem (Cook, 1995; Fulton, 2001; Nilsson, 2001; Vitaliano, 1983; Staatz, 1989). These problems may have contributed to the problem of mobilizing equity capital and thus led to excessive borrowing by some co-operative.

Bank financing is one of the most important sources of capital for co-operatives because (i) it does not violate any of the co-operative principles, (ii) it does not require member investment, (iii) it is easy to administer, and (iv) it is applicable for all sizes of co-operatives including new and emerging organizations (Ernst and Young, 2002). However, anecdotal evidence suggests that hitherto since banks have had little confidence in co-operative agribusiness firms, the interest rate, terms of reimbursement and other conditions that banks propose tend to be highly unfavourable to the co-operative agribusiness and the guarantees required by banks can be exorbitant. One of the reasons why banks put forward these conservative loan conditions is that financial institutions may treat the co-operative's equity (or member contributions) as an outstanding debt/liability for the company.

This fact may force co-operative firms to look for other ways to raise external equity capital through issuance of preferred shares, sponsor shares, special certificates, etc. (Sven, 1992) (e.g., from employees, public investors, closely related co-operatives).

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[10] Patronage ("Dividend") payment is a taxable distribution made by a co-operative to its members or patrons.

These may even be more difficult means through which to obtain capital. These ways of raising external equity capital, however, have resulted in the modification of the traditional co-operative form (Chaddad and Cook, 2004) and impacted the co-operative principles. As a result, alternative co-operative business forms and financial models for co-operative organizations have emerged that are driven by equity capital: proportional investment co-operative (e.g., Dairy Farmers of America in the U.S.), member investor co-operatives (e.g., Compina in the Netherlands), new generation co-operatives (e.g., proposed Ranchers Choice Beef Co-operative, in Canada), co-operatives with capital seeking entities (e.g., Kerry Co-operative Creameries Ltd. in the Ireland), and investor-share co-operatives (e.g., Saskatchewan Wheat Pool in Canada; Calavo Growers in the U.S.), investor-oriented co-operatives (e.g., United Grain Growers in Canada). For details on the emerging co-operative typology and financial models see Chaddad and Cook (2004).

In Canada, for example, the Saskatchewan Wheat Pool (SWP) became a publicly traded agribusiness co-operative firm with its class B shares listed on the Toronto Stock Exchange in 1996 (SWP, 2002). The SWP issued shares to raise external equity capital. United Grain Grower (UGG), a farmer's co-operative founded in 1906, also made an initial public offering of an estimated $20 million in common shares in July 1993 (McFarland, 1993). In 1997, Archer Daniels Midland (ADM), an American multinational company, purchased a stake (45 per cent) in UGG and it eventually became an IOF. The rationale behind the public share issue by UGG in 1993 and Saskatchewan Wheat Pool in 1996 was that in order to compete, traditional co-operatives needed access to public stock markets to finance their growth (Ingram, 1998).

From the co-operative principle point of view, the implication of this move was that these companies became "hybrid" organizations meaning that they were neither true co-operatives nor purely publicly traded companies. However, share values for both co-operative public offerings plummeted quickly to ridiculously low levels, necessitating UGG's sale to ADM and SWP's current capital restructuring plan. In November, 2001 UGG merged with Agricore[11] to form Western Canada's leading farmer directed agribusiness. A closer look at **Figure 1-5** suggests that share prices for SWP were consistently declining over the period 1998 to 2003. The monthly stock price history indicates that the share price for the SWP plummeted from approximately $22 per share in July 1998 to as low as $0.33 in December 2004. For Agricore United, share prices have decreased from as high as $15.05 in June 1997 to $4 in February 2003 (**Figure 1-6**). Some other recent examples of moves toward demutualization include Warrnambool Cheese and Butter and Dairy Farmers (in Australia), Kerry Dairy Co-operative (in Ireland), and Calavo Growers of California (in the U.S.). Other alternative financial models followed by many co-operatives in Canada and elsewhere are strategic alliances (e.g., Dairy Farmers of America in the U.S), merger (Alberta Wheat Pool and Manitoba Pool Elevator in Canada), trust companies (e.g., Diamond Walnut Capital Trust in the U.S), and equity share transferability (e.g., Tatura Co-operative Dairy Company in New Zealand) models.

In summary, following increasing capital requirements traditional co-operative agribusiness firms may use excessive debt financing since both internally and externally

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[11] Agricore was created as a result of a merger of Manitoba Pool Elevators and Alberta Wheat Pool that occurred in mid-1998.

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generated equity capital are limited (Chaddad, 2001) as compared to other corporations. The use of borrowed capital means that a share of the operating profits must be allocated to meeting the interest charge on the debt capital before the owners of the equity capital can take their reward. Excessive leverage (i.e., the ratio of debt to equity) is the primary source of financial risk for traditional co-operative firms and the holding of sufficient equity capital is a major response to such risks. Traditional co-operatives may also be constrained in their ability to obtain debt capital as lenders consider the equity of co-operatives as inadequate to support loans (Vitaliano, 1983).

1.5 Research Problem Statement

The previous discussion concerns the inability of co-operative agribusiness firms to raise adequate equity capital and the potential impact of this inability on the future growth of the sector. This highlights the importance of taking into consideration the effects of leveraging in the analysis for economic performance of co-operative agribusiness firms.

In the past, Canadian agribusiness supply and marketing co-operative members have likely benefited from their co-operatives. However, the benefits accruing to members of co-operatives may depend on both the short-term profitability and long-term growth of their organization. One of the impediments to the growth of Canadian agricultural co-operatives, particularly agribusiness marketing co-operatives, is the capitalization issue (i.e., capital constraints) they are facing in order to finance increasing capital requirements. As a result, many co-operatives have indulged in excessive borrowing. It is of great importance and interest for members of agricultural co-operatives to understand the impact that excessive borrowing may have on the co-operative sector, specifically under poor economic conditions. The issue around capital structure of co-operatives has also attracted public attention. A new Canadian Co-operative Act that may enable co-operatives to have greater access to sources of capital other than member capital, allowing them to better compete with IOFs, was passed on June 17, 1999.

After a period of relatively low capital investment, co-operatives in Canada started to make huge investments in the late 1980s. Traditional co-operatives investments are mainly financed through borrowing rather than funding by members or private investors (Belhadji et al., 2000) because of equity capital constraints (Chaddad, 2001; Parliament and Lerman, 1993).

The fact that Agrifoods International was sold (Canadian Dairy Information Center, 2002) and SWP is in a serious financial trouble (Byfield, 2002) suggests that debt leveraging may have been too high. Put differently, co-operative agribusiness firms are going out of business or changing their business model due to their capital structure and competitive rivalry from the global marketplace which may have negatively impacted the welfare of co-operative members and the society. As Enke (1945) pointed out, the maximization of the sum of members' welfare is equivalent to the maximization of the welfare of the co-operative members and the society. Because co-operatives are maximizing the sum of members' welfare (Enke, 1945), with increasing market concentration/power in the agribusiness sector (Lopez, 1984; Cranfield et al., 1995; Fulton and Tang, 1999; Qian, 2004; Cranfield et al., 1995; Lopez, 1984) co-operative members and the society may face a significant welfare loss if co-operatives are going out of business or restructuring themselves.

Qian (2004) reported the existence of significant market power in the poultry industry in Canada over the period 1976-2001. Fulton and Tang (1999) found support for the hypothesis that the retail chicken prices increased due to the presence of market power at either (or both) the processing or retailing level over the period 1965/66-1995/96. Using data over the period 1965 to 1990, Cranfield et al. (1995) found that oligopoly power existed in the dairy, fruits and vegetables, poultry and red meat processing industries. Lopez (1984) as well found substantial departures from competitive behaviour in Canadian food processing industry.

According to Dickson and Yu (1989) and Dickson and He (1997), the size of welfare/deadweight loss for an industry depends, among other things, on the seller/buyer concentration. The major concern about this concentration is the control exercised by a handful of firms over decision-making throughout the food system. As agriculture becomes more concentrated and integrated, these giant clusters maintain an oligopoly (oligopsony) power – a market in which a small number of sellers (buyers) exerts power over a large number of buyers (sellers) – over large parts of the agri-food chain, enabling them to maximize profit while minimizing risk. As cited in Fulton and Tang (1999:229), "*Questions about retail concentration have emerged as a public issue recently with the announcement of possible mergers in the food retailing sector* (Globe and Mail, 1998)."

Dickson and He (1997) argued that although more firms imply reduced market power, this may not offset the adverse impact of higher unit costs resulting from not exploiting economies of scale. For co-operatives this trade-off may not be an issue since by their very nature co-operatives are organized to overcome market power. At the same time they may be able to exploit economies of scale by growing in size resulting in lower unit costs of production. However, in order to assure the members' and society welfare maximization, co-operatives should be financially viable and be able to address issues around capital constraints. Among other things, the common issues some of the co-operative agribusinesses are currently facing may be due to: (i) equity capital constraints and excessive debt capital and lack of financial risk management knowledge in agribusiness co-operatives in the short run/long run (ii) the divergence in attitudes towards debt leverage risks between members of co-operative managers and their board of directors; (iii) agency costs resulting from conflict of interest between members of co-operative management and directors/members; and/or (iv) cost inefficiency of resource use. Questions related to these issues include: (i) What are the impacts of excessive debt on agribusiness co-operative performance? (ii) Are both supply and marketing co-operatives equally affected by the issues around capital constraints? (iii) What is the impact of differing risk attitudes between managers and directors on co-operative members' welfare? and (iv) What is the impact of excessive debt on cost efficiency of agribusiness co-operatives firms?

To this end, within the framework of global market and increased competitive rivalry, the consequences of capital constraints can be summarized as limiting agricultural co-operatives in their strategic investments, thus making them vulnerable to competition. Taking into account the economic, social, political and cultural importance of agricultural co-operatives to a large number of the rural communities in Canada, this vulnerability may affect the well being of those who have chosen to participate in co-operatives. These issues around capital structure and their implications for the performance of agricultural co-operatives are broadly discussed under the following sub-sections.

1.5.1 Capital Structure and Financial Theory

Finance theory states that if (i) capital markets are perfectly competitive, (ii) there are no transaction costs, (iii) there are no bankruptcy costs, (iv) there are no corporate or income taxes, and (v) all agents have the same information, then the market value of investor-owned firms (IOFs) are unaffected by financing decisions (Modigliani and Miller, 1963; Fama, 1978). For example, the distinction between debt and equity financing reduces largely to terminology under certainty. Unlike IOF stock, co-operative equity is not marketable. The value of a non-co-operative corporation is measured by the market value of equity ownership. On the other hand, the value of a co-operative business is based on the value it provides member-patrons through the patronage relationship, and the concept of value is an entirely internal forum based on complex interrelationships. There is no motivation for patrons and non-patrons to invest in a co-operative since the distribution of co-operative profits is based on the size of patronage, and not investment. In short, maximizing the value of a co-operative business differs from maximizing the value of a non-co-operative business. Therefore, it is important to fully understand the internal dynamics of the co-operative being judged when determining value from the perspective of market place. There are no secondary markets for co-operative stock, and the Modigliani and Miller no-arbitrage proof may not directly apply to co-operatives. The theoretical implication of the no-arbitrage proof for a co-operative is a question of further theoretical investigation.

Others have argued that capital structure does matter when agency costs (Jensen and Meckling, 1976), corporate income taxes (Modigliani and Miller, 1958), asymmetric information (Myers and Majluf, 1984), risk attitudes (Robison and Barry, 1987), market interaction (Jensen and Meckling, 1976) and economic and financial trade-offs (Miller, 1977) are present. For example, the use of traditional Net Present Value (NPV) in investment analysis assumes that managers maximize shareholder wealth (Stulz, 1996). According to Stulz (1996), if managers act to maximize their own utility rather than maximizing the shareholders wealth, capital investment decisions may need to take into consideration the potential agency costs of managerial discretion. The question to ask is then *does capital structure matter for agribusiness co-operatives firms?*

1.5.2 Divergence in Risk Attitudes

Part of the problem relating to capital structure may be explained by possible indirect costs resulting from divergence in risk attitudes between managers and the owners (i.e., BODs and managers). While measuring the level of risk exposure and developing risk-based ranges of optimal debt policies are essential elements for the success of co-operative agribusinesses, the extent to which managers or BODs exhibit risk taking or risk avoiding behaviour when making decisions with a variety of financial data is also of specific interest. According to Robison and Barry (1987), optimal debt load depends, among other things, on the decision maker's risk attitude. A divergence in risk attitudes between co-operative managers and their BODs may cause increased indirect costs. This occurs because of managerial incentive structures or managers not acting in the best interests of the members or the BOD providing the wrong incentives to their managers, among other factors. In managing the capital structure and the resulting indirect costs of divergence in risk behaviour, explicitly exploring the impact of these differences in attitudes towards different level of financial risk exposure is important. The role that the divergence in attitudes between co-operative managers and BODs towards financial risks plays in determining the capital structure needs to be identified. However, *do differing risk attitudes have significant economic influence on the performance of agribusiness co-operatives in Canada, thereby affecting their members' welfare?*

Several studies have focused on the relationship between owners and managers where owner involvement in co-operatives is believed to be a possible basis of performance difference and long term competitive advantage (Katz, 1997; Parliament and Lerman, 1993). Nevertheless, limited empirical research exists examining the influence of BOD-manager risk attitude divergences on the level of debt risk exposure in co-operative agribusiness firms. The indirect costs associated with divergence in attitude between managers and BODs need to be taken into account when undertaking investment activities. The co-operative BODs and managers' attitude (divergence) toward debt leveraging risk will be explored using behavioural models.

1.5.3 Agency Costs of Debt

In a situation where management maximizes its own utility and its interests do not coincide with the objective of maximizing members' wealth, exploring the agency costs associated with asymmetric information between managers and members is important in the determination of the appropriate cost of capital.

Agency problems arise if (i) the owner of the firm delegates a task to a manager who has an incentive incompatibility constraints and (ii) the information about the manager is imperfect. Agency problems may even be more pronounced in the case of a co-operative firm where managers of the firm may not have share ownership rights. Unless the agency problems are resolved they lead to suboptimal allocation of resources within the organization, resulting in increased costs of production (Barnea et al., 1985). Agency problems related to excessive debt arise from asymmetric information, risk incentive, investment incentive, and bankruptcy problems (Barnea et al., 1985; Jensen and Meckling, 1976).

According to Myers (1977), as the leverage of a business increases, the equityholders have an incentive to choose investment projects that reduce the total firm value, referred to as the incentive to under-invest in positively valued projects. This occurs because the costs of investment are borne by the equityholders while the benefits of the new investment accrue to debtholders (Kim and Maksimovic, 1990). Incentive conflicts due to information asymmetry result in agency problems of debt financing and affect production and investment decisions (Hossain and Jain, 2001). Chan-Lau (2001) stated that as compared to equity financed firms, underinvestment amounts to the early liquidation of the debt-financed firms. This in turn may lead to misallocation of resources due to under-investment in some inputs. This misallocation of the debt capital may cause agency costs of debt in the co-operative business resulting in inefficient allocation of co-operative resources (Kim and Maksimovic, 1990; Featherstone and Al-Kheraiji, 1995). The research question is then "*have agency costs of debt affected the performance of Canadian agribusiness co-operatives?*"

In general, relatively few studies have estimated and tested the impact of agency costs of debt on costs of production or productivity of firms (e.g., Kim and Maksimovic, 1990; Featherstone and Al-Kheraiji, 1995; Bernstein and Nadiri, 1993; Hossain and Jain, 2001). For example, for selected U.S. agricultural supply and marketing co-operatives the agency costs of debt were 1.67 per cent of the variable costs for a 10 per cent increase in the level of debt (Featherstone and Al-Kheraiji, 1995). The empirical evidence from these studies indicates that the estimated magnitude of agency costs would undoubtedly influence the firm's capital structure decision. Therefore, in the presence of the agency costs of debt, other things being equal, the higher the level of debt leverage, the lower the value of the company. This also suggests that the capital structure matters in the firm's financial decisions.

Despite the fact that there are theoretical claims that agency costs might be more important in co-operatives than investor-owned firms (IOFs) (Chaddad, 2001; Vitaliano, 1983; Porter and Scully, 1987; Katz, 1997), there are few quantitative studies of agency costs of debt (Featherstone and Al-Kheraiji, 1995) in co-operative agribusiness firms. There are none in the Canadian co-operative agribusiness firm context. Measuring and testing the agency costs of debt for agribusiness supply and marketing co-operatives in Canada may provide additional information leading to a better decision-making process.

1.5.4 Efficiency of Resource Use

An equally interesting and related problem concerns the relationship between capital structure (i.e., the level of indebtedness relative to assets) and efficiency of resource use. The degree of efficiency attained by agribusiness co-operatives contributes directly to resource productivity and is a significant determinant of business performance. This is because cost efficiency determines a firm's success in choosing an optimal set of inputs for producing a given level of output. Cost inefficiency affects profits and growth through the negative effect of wasted resources and earnings and cash flows due to suboptimal usage of the firm's resources (Greene and Segal, 2004). Because co-operatives can be characterized by capital constraints (Chaddad, 2001), the impact of efficiency on co-operative firm profitability is particularly important since profitability, among other things, determines the ability of the co-operative firm to invest and grow through its contribution to retained earnings. Thus effort is made to answer: "*what is the relationship between capital structure and cost efficiency of Canadian agribusiness co-operatives?*"

In terms of the relationship between capital structure and cost efficiency three main hypotheses have been developed in previous studies (Nasr et al., 1998): agency theory (Jensen and Meckling, 1976); free cash flow (Jensen, 1986); and credit evaluation. According to agency cost theory firms may be operating at various level of cost inefficiency due to poor incentive structures. That is, a suboptimal outcome for the principal, and a suboptimal measured efficiency for the analyst, may result because of agency problems (Bogetoft, 2000). The agency theory of debt hypothesis (Jensen and Meckling, 1976) emphasizes the costs of monitoring, bonding, and adverse incentive that might be transferred to borrowers by banks suggesting highly indebted borrowers are less cost efficient. On the other hand, when there are excessive cash flows in a co-operative firm, the free cash flow hypothesis or the control hypothesis (Jensen, 1986) postulates that debt motivates managers to become more efficient. Finally, the credit evaluation hypothesis states that banks will prefer to finance more efficient firms because these borrowers have lower credit risks. In summary, the agency cost concept implies a negative relationship between efficiency and financial structure (Jensen and Meckling, 1976), while the free cash flow (Jensen, 1986) and credit evaluation concepts suggest positive relationships (Nasr et al., 1998). In general, efficient use of limited resources may enable co-operative firms to partially alleviate the capitalization issues co-operatives are facing currently.

It seems logical that increased efficiency is an important step in improving the competitiveness of the co-operative sector and in ensuring their continued viability. Previous evidence suggests that not all co-operative firms are successful in solving their optimization problems; that is, not all co-operatives are cost efficient. As a result, not all co-operatives succeeded in maximizing their production activity that enables them to achieve higher returns for patronage payment and future growth.

1.6 Objectives of the Study

The overall objective of the study is to explore the impact that capital structure has on the performance of supply and marketing co-operatives in Canada. The specific objectives of the study are: (i) to determine if there are agency costs of debt and to scrutinize the relationship between agency costs of debt and the variable costs of production for five cases of Western Canadian co-operatives; (ii) to explore the impact that differing attitudes towards debt financing, if any exist, have on the welfare of co-operative members using a survey of members of co-operative management and directors; and (iii) to estimate firm level cost efficiency and to investigate the influence that capital structure has on the cost efficiency of Canadian agribusiness supply and marketing co-operatives

1.7 Significance of the Study

Despite the fact that agency costs may determine the co-operative firm's financial structure and the prediction that agency costs may have a negative impact on firm performance, there is no evidence with respect to the magnitude of agency costs in co-operative agribusiness firms in Canada. In this study, the agency costs, as reflected by the misallocation of inputs, are estimated by specifying and econometrically estimating cost functions of co-operative firms. Quantification of the agency costs of debt is helpful to the co-operative firm in evaluating the profitability of a capital investment or the advantage of alternative financing sources by determining the indirect costs of capital. In addition, quantifying the agency costs due to misallocation of resources could provide useful information for co-operatives when hiring managers and/or signing contracts. Conceptually, the study contributes to the theory of agency costs under the co-operative agribusiness firm framework. That is, it is the first study to provide a rigorous and direct test of the agency costs of debt for Canadian agribusiness co-operatives using a firm-level data set.

The understanding of divergence in risk behaviour between managers and BODs is important in the process of appointing management and designing compensation incentives. Another important contribution that this study has for the co-operative sector is with regard to the role that understanding of differences in attitudes plays in the firm. Conceptually, this study contributes to the co-operative literature by using economic and social psychological theories to explain the relationship between decision makers unobserved risk attitude, level of debt leveraging and socio-economic characteristics of individuals. The study provides a better understanding of factors underlying why co-operatives are currently facing financial distress. No previous studies have investigated the relationship between divergence in the risk attitude of managers and BODs, on the level of risk of debt leveraging and members' welfare in Canada both for co-operative and other businesses. Most importantly, it is the first study to provide a measure of risk attitudes of co-operative BODs and managers in Canada. The understanding of divergence in risk attitude between managers and BODs may also help co-operative firms reduce the costs of risk.

Closely related to the issue around agency costs is the question why efficiency is so important to the co-operative sector. Efficiency impacts unit cost of production, thereby having the potential to increase co-operative competitiveness in both domestic and global marketplace, to improve co-operative sector profitability and to enhance long-term viability/sustainability of the co-operative sector. By studying the relationship between debt leverage and efficiency this study provides quite valuable insights into the impact that agency costs of debt has on cost efficiency. In addition, the important contribution to the theoretical account is that it is the first study to provide a rigorous analysis of efficiency for Canadian co-operatives in a range of industries, by correcting for differences in technologies across firms in the same industry.

1.8 Organization of the Study

This study has five chapters and is organized as follows. In this first chapter, an overview of the historical formation of co-operatives is discussed, a brief review of the economic theory of co-operatives and the alternative behavioural framework for co-operative business is provided, a background of the Canadian agribusiness co-operative sector is presented, current challenges faced, and issues around alternative capital sources within the general framework of co-operative finance literature and the research problem statement are presented and finally the significance of the study and an overview of co-operative theory are presented.

In Chapter 2, results from the estimation of cost functions for five "cases" of Western Canadian co-operatives are presented. Based on firm level data, agency costs of debt are measured and compared across firms with different business and industry structure. A test for the presence of a capital constraint is also conducted and results are presented.

Survey results on differing risk attitudes between managers and directors of co-operative firms are explored in Chapter 3. The impact that any divergence in risk attitudes and decision-making power might have on financial leverage and members' welfare is explored. As well, the degree of awareness of risk management strategy by managers and directors of co-operative firms is investigated.

In Chapter 4, cost efficiency is measured for a panel of agribusiness supply and marketing co-operatives using a random parameters stochastic frontier model. Firm level cost efficiencies that are corrected for heterogeneity in technology across co-operative firms are presented. The impact of financial leverage on cost inefficiency is investigated.

In the fifth and final chapter a summary, conclusions, policy recommendations, and future research directions are presented.

Table 1-1: Types of Non-Financial Co-operatives in Canada and Number of Associations, Number of Members, Number of Employess, Sales Volume and Assets Sizes, By Type in 2001

Type of co-operatives	Associations (Number)	Membership (Thousand)	Employees (Thousand)	Sales (Billion $)	Assets (Billion $)
Consumer	555	3513	23.829	8.261	3.116
Supply	244	316	6.060	3.307	1.297
Marketing	172	205	30.141	15.748	5.286
Fishery	57	7	2.186	0.226	0.076
Production	598	39	6.417	10.057	0.646
Service	4198	676	10.865	1.577	6.974
Total	5824	4756	79.498	39.176	17.395

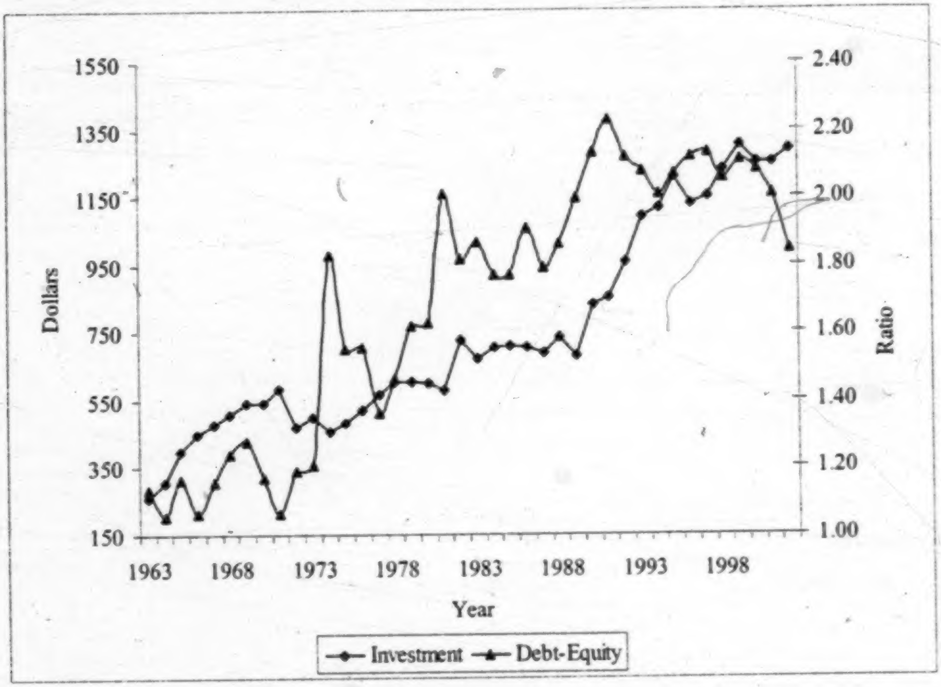
Source: Co-operative Secretariat, Government of Canada. 2003. Co-operatives in Canada

Table 1-2: Estimates of Trends in Market Shares (per cent) of Selected Agricultural Marketing and Supply Co-operatives in Canada (1985-2001)

	1985	1990	1991	1995	1996	1997	1998	1999	2000	2001
Dairy	58	46	59	57	59	62	64	66	59	42
Poultry and Eggs	37	40	39	51	57	51	51	53	49	49
Grains and oilseeds (West)	74	75	74	55	54	54	51	49	47	45
Honey and Maple	23	29	21	24	16	22	20	21	27	28
Livestock	30	32	14	18	20	18	20	19	11	14
Fruit and vegetables	33	26	13	23	32	21	23	15	6	8
Fertilizer and chemicals	--	--	36	--	--	--	--	--	40	41
Farm Petroleum	--	--	29	--	--	--	--	--	31	32
Feed	--	--	25	--	--	--	--	--	15	15
Seeds	--	--	17	--	--	--	--	--	11	8

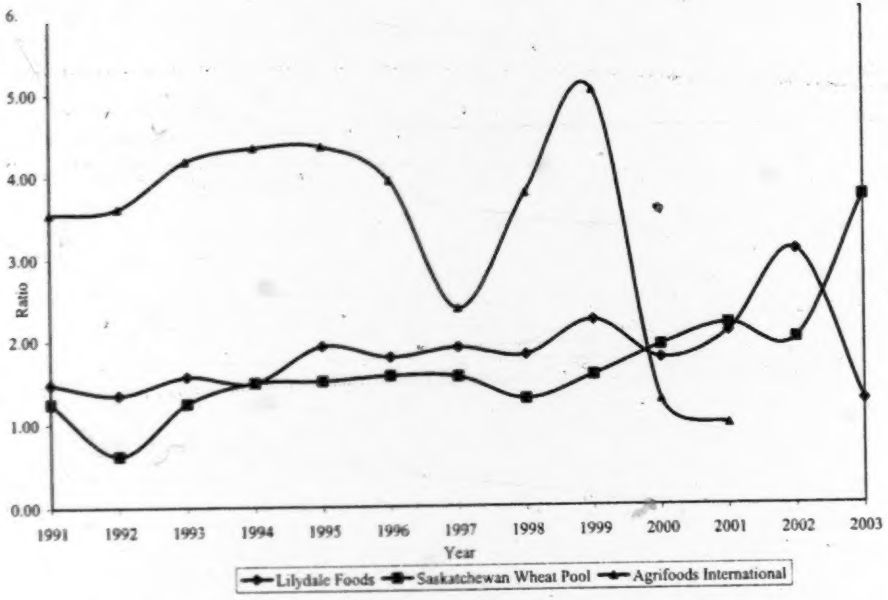
Source: Co-operative Secretariat, Government of Canada.1985-2003. Co-operatives in Canada

Figure 1-1: Real Capital Investment (Million Dollars) and Debt-Equity Ratio for Co-operatives in Canada, 1963-2002 (1992 Dollars)



Source: Co-operative Secretariat: Government of Canada. 1963-2002. Co-operatives in Canada

Figure 1-2: Debt to Equity Ratio for Lilydale Foods, Agrifoods International, and Saskatchewan Wheat Pool Co-operatives, 1991-2003



Source: Individual Co-operative's Annual Reports (Various Years, 1991-2003)

Figure 1-3: Alternative Optimization Problems for Marketing Co-operative Firms

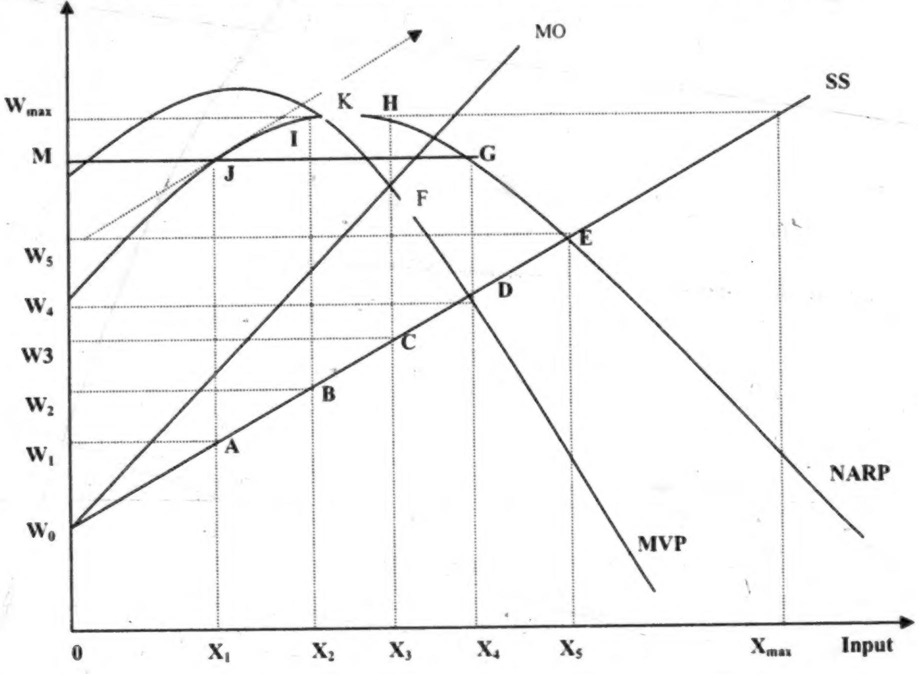


Figure 1-4: Alternative Optimization Problems for Supply Co-operative Firm

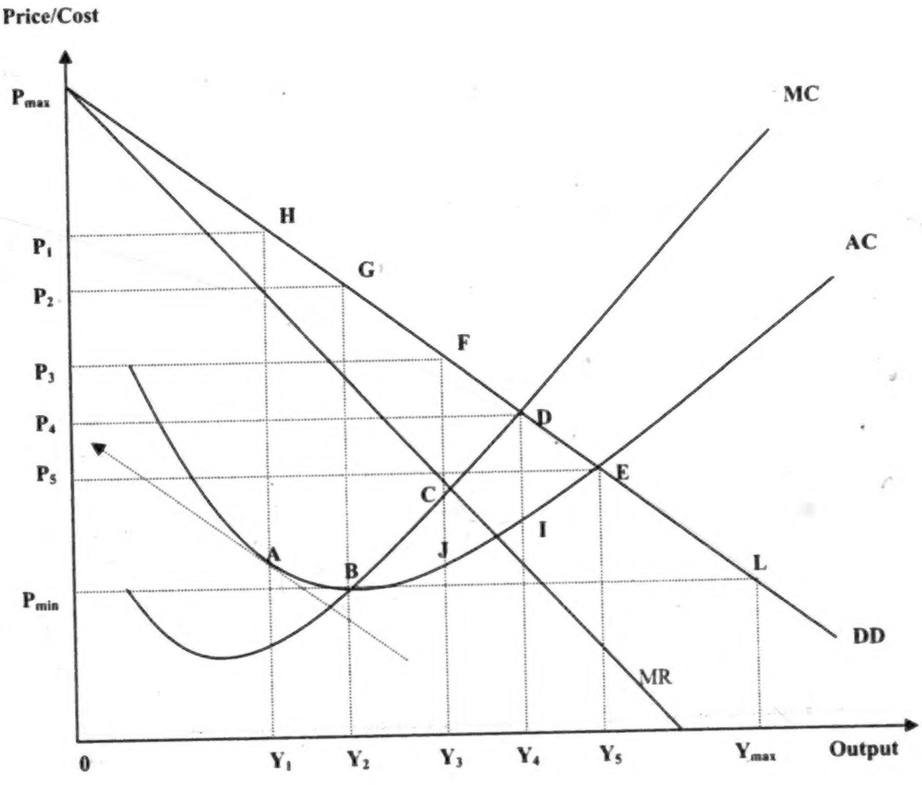
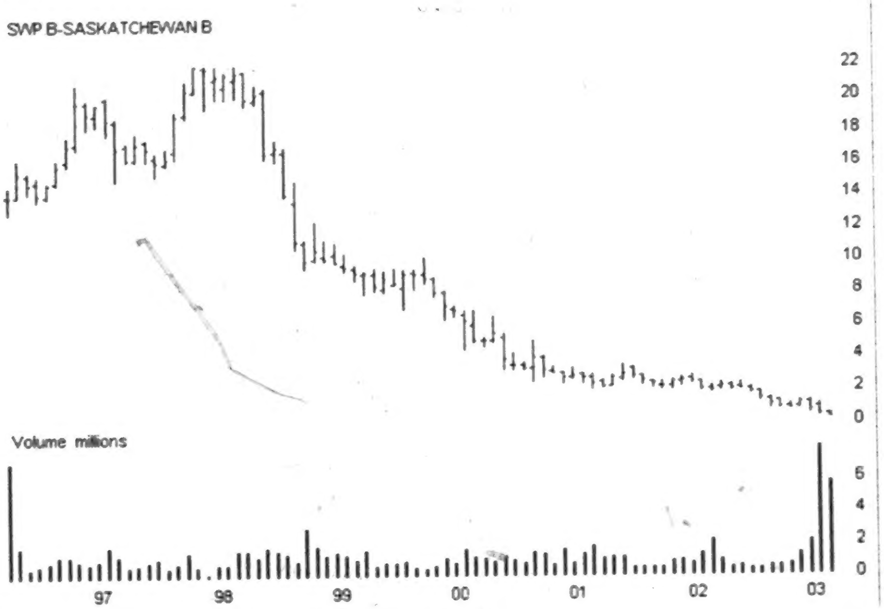
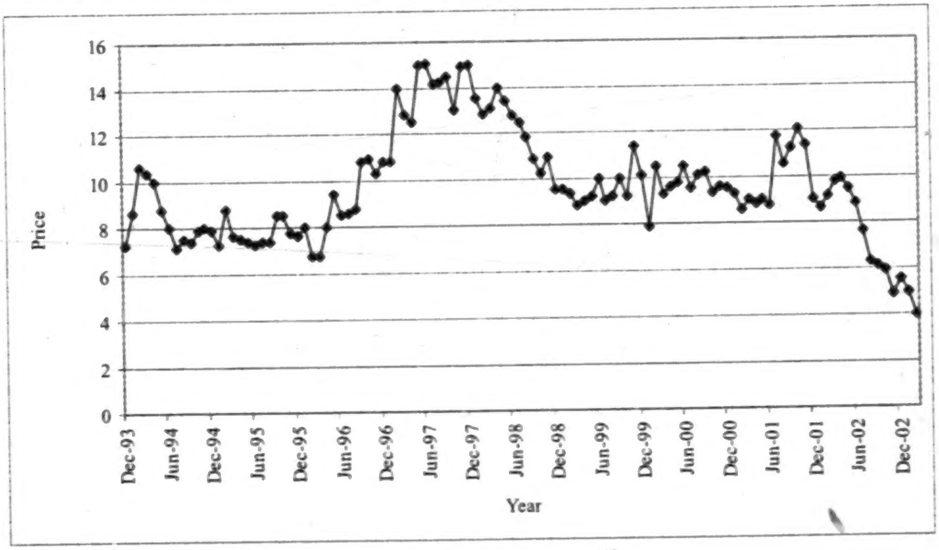

Price/Cost
P_{max}
P_1
P_2
P_3
P_4
P_5
P_{min}
MC
AC
DD
MR
H
G
F
D
E
C
I
J
A
B
L
0
Y_1
Y_2
Y_3
Y_4
Y_5
Y_{max}
Output

Figure 1-5: A Monthly Share Prices and Volume for Saskatchewan Wheat Pool (1996 – 2003)



Source: FP Corporate Reports (March 24, 2003)

Figure 1-6: Monthly Share Prices for United Grain Gowers (1993-2001) and Agricore United (November 2001 – present)



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Chapter 2: Agency Costs of Debt and Capital Constraints: The Case of Western Canadian Agricultural Supply and Marketing Co-operatives[1]

2.1 Background

Agency theory, as described by Jensen and Meckling (1986), is concerned with the divergence between the agent's decisions and those decisions which would maximize the welfare of the principal. Researchers have studied agency costs associated with capital structure decisions for several years in many contexts. This study examines the agency costs of debt for agricultural marketing and supply co-operatives in Canada.

One of the problems with debt financing is that the incentives facing the leveraged firm's managers, as delegates of the firm owners, may not be appropriate to ensure optimal operating decisions. It is possible, with "distance" between managers and owners of the firm, that the firm may not maximize its profit because of asymmetric information (Laffont and Martimort, 2002). As Jensen and Meckling (1976) argue, the manager is more likely to undertake projects that increase his/her personal benefits in spite of the increase in debtholders' exposure to risk than would occur if the manager financed the project with his/her own funds. Because of (i) the incentive to over-invest due to asset substitution, demonstrated by Jensen and Meckling (1976), (ii) an incentive to under-invest (the debt overhang period) due to limited liability shown by Myers (1977), (iii) on the job excessive perquisite consumption due to partial ownership of the firm, asymmetric information (Barnea et al., 1985) and/or (iv) inefficient liquidation policy (Harris and Raviv, 1990), higher leverage may result in a behaviour which increases the expected cost of producing a given level of output (Kim and Maksimovic, 1990). Consequently, the owners of the firm are forced to suffer the full burden of the increased costs of production resulting from separation of ownership and control.

Myers (1977) argues that investment opportunities can be seen as options. Since the shareholders have to pay for the investment where the gains accrue primarily to the debtholders, the management of a firm in financial distress may forgo some potentially profitable investments. That is, managers believe that capital markets undervalue their firm's risky securities, and may decline to undertake positive net present value projects that must be financed externally. In situations where only little benefits from the new investment project go to the shareholders, abandoning these investment opportunities is a rational decision. From the shareholders' perspective, the net present value of the new investment project is negative, although the overall net present value of the project may be positive. Thus, managers acting in the best interest of the shareholders abandon these investment opportunities, resulting in a reduction in the overall firm value.

Conversely, in the case of over-investment (Jensen and Meckling, 1976), the firm's management may engage in a risky investment with a negative net present value, since potential gains accrue to the shareholders whereas the potential losses are borne by the debtholders. That is, managers overvalue their own corporate projects and may wish to invest in negative net present value projects even when they are loyal to shareholders.

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[1] Versions of this chapter have been published. Hailu, Jeffrey, Goddard, and Ng. 2005. Journal of Food Distribution Research, XXXVI(2):39-49 and Hailu, Jeffrey, and Goddard. 2004. Journal of Food Distribution Research, XXXV(1):110-111.

The principal-agent problem is more severe and complex in a co-operative than in a corporation (Porter and Scully, 1987). Because the members' shares cannot be traded in a free market, the net cash flow cannot be capitalized and sold and there is no external information available to the principals to evaluate the performance of the agent (i.e., the manager). Porter and Scully (1987) argue that "since the gains to managerial efficiency cannot be capitalized, the incentives to monitor are reduced." Decision making functions are in the hands of managers who are not residual claimants. In the absence of decision making control applied on behalf of residual claimants, managers will tend to manage decisions in a manner that will lower the value of the co-operative's residual claimants (Vitaliano 1983). Residual claims are usually exchanged for capital resources, and an organization's residual claimants are the agents that bear the financial risk of the organization's activities.

Torgerson et al. (1997) argue that a challenge for the co-operative members is to remain the primary beneficiary of group action for which they originally organized and not to become the "residual" claimant in the sense of crumbs left over after all other agent groups receive their due. This is particularly critical in organizations lacking firm board governance control and in instances where management continues to push for sales growth involving non-member related business activity. As noted by Royer (1992) and Staatz (1989), it becomes even more critical when co-operatives develop large unallocated reserves based on this non-member business that represents a form of "collective" equity. Management invariably views this equity as the product of its efforts rather than those of the members. According to Staatz and Royer, there is a great potential for the character of co-operative organizations to change or be compromised in such situations, particularly in larger complex organizations. Some of these situations have even led to conversions to investor-owned firms (e.g., Agricore United in Canada), or to members losing control through goal inversion in which maintaining the "corporate" values becomes more important (e.g., Saskatchewan Wheat Pool in Canada) than keeping the business oriented to members as primary beneficiaries (Torgerson et al., 1997).

In sum, whether a firm is a co-operative or a corporation, substantial costs may arise from using restricted covenants to resolve costly conflicts of interest. The costs arising from conflicts of interest between managers (i.e., agents) and capital providers (i.e., principals) are the agency costs of debt. These agency costs may lead to higher costs of financing and hence higher costs of producing a given level of output. If these problems are not resolved they likely lead to inefficient resource allocation. In the case of co-operative firms, the absence of equity-based compensation schemes (or absence of share ownership), as opposed to investor owned firms, may provide further incentives for the managers not to expend more effort, than if the manager had been offered partial ownership of the firm's equity.

In contrast to the above argument, Jensen (1986) and Grossman and Hart (1982) argued that debt leverage may lead to a potential improvement in efficiency by reducing managerial discretion over free cash flow. Managers want to retain free cash flows and invest them in projects that increase managerial benefits like compensation or power and reputation (e.g., Avery et al., 1998). Shareholders want managers to pay out free cash flows, because the projects that increase managerial benefits often may be negative net present value projects. Debt leverage may lower the likelihood that resources are allocated to investments with negative net present value (Jensen, 1986). Leverage increasing transactions that bond the firm to pay out free cash flows increase shareholder value and mitigate the conflict of interest between shareholders and managers. In this situation, a higher degree of resource use efficiency may result from excessive debt leverage. In the case of co-operative firms, if the capital constraint hypothesis holds it is unlikely that co-operative firms would benefit from increased debt leveraging. In sum, while the potential costs and benefits of debt leverage[2] are generally well recognized, whether debt leverage forces co-operative agribusiness firms toward efficient behaviour or inefficient behaviour is an open empirical question. Some argue that capital structure does matter when capital markets are imperfect due to differing market incentives (or agency costs) (Jensen and Meckling, 1976), corporate income taxes (Modigliani and Miller, 1958), asymmetric information (Myers and Majluf, 1984), market interaction (Jensen and Meckling, 1976) and economic and financial trade-offs (Miller, 1977). For example, in balancing tax benefits and agency costs of debt (or default costs), an optimal capital structure may exist. When perfect and costless monitoring (full information) is unavailable, understanding the costs associated with differing market incentives may help managers and boards of directors in making better financial and production decisions. Capital investment decisions or capital budgeting analysis should take into account the agency costs of debt.

The objective of this study is to determine if there are agency costs of debt for five cases of Western Canadian co-operatives. Specifically, a test for the existence of agency costs of debt is conducted for selected co-operative agribusiness firms. The implications of different industry regulatory conditions on agency costs of debt are also examined for supply managed and non-supply managed marketing co-operatives. Furthermore, the effect of co-operative structure (marketing versus supply co-operative) on agency costs of debt is assessed.

The contributions of this study are (i) costs of differing market incentives- agency costs- are empirically measured; (ii) the implication of regulatory environment on agency costs of debt or resource allocation is demonstrated theoretically and tested empirically using five case firms; (iii) cost structure and input demand for case co-operatives are explored; and (iv) the impact of co-operative governance structure on agency costs of debt is examined.

In the following sections, literature review, conceptual models, data description, model results and discussion, and concluding remarks are presented and discussed.

2.2 Literature Review

In the determination of optimal capital structure various studies have investigated the agency problems of debt structure without explicitly quantifying the associated costs. Among others, Myers (1977), Titman and Wessels (1988) and Shleifer and Vishny (1997) studied the impact of agency costs on capital structure. None of these studies explicitly quantified the agency costs of debt in a statistically testable way. Other studies have tried to quantify and statistically test the agency costs of debt leveraging (e.g., Kim and Maksimovic, 1990; Mello and Parsons, 1992; Featherstone and Al-Kheraiji, 1995; Bernstein and Nadiri, 1993; Hossain and Jain, 2001) using various techniques. For example, Mello and Parsons (1992) applied contingent claim techniques to measure the agency costs associated with debt leverage by including a stochastic variable that determines the firm's value. They concluded that the estimated magnitude of the agency costs of debt would certainly be an important determinant of the firm's capital structure decision.

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[2] Finance theory states that if capital markets are perfectly competitive, there are no transaction costs, there are no bankruptcy costs, there are no corporate or income taxes, and all agents have the same information, then the market value investor-owned firms are unaffected by financing decisions (Modigliani and Miller, 1958; Fama, 1978). For example, the distinction between debt and equity financing reduces largely to terminology under certainty.

Kim and Maksimovic (1990) measured the agency costs of debt by first explicitly defining a two-period production process for the firm and then testing whether or not the estimated agency costs were statistically significant. For the airlines industry, Kim and Maksimovic (1990) used three variable inputs (labour, fuel and material), four outputs (revenue passengers, miles of schedule and charter services, revenue ton-miles of mails and all other freight) and one fixed input (capacity) aggregated using a multilateral index. Kim and Maksimovic (1990) measured agency costs by estimating a variable cost function for the U.S airline industry and found that a 10 per cent increase in the debt level resulted in a 0.34 per cent increase in variable costs. Kim and Maksimovic (1990) used long-term debt and the net present value of lease commitments as a measure of indebtedness. By adopting the technique developed by Kim and Maksimovic (1990), Featherstone and Al-Kheraiji (1995) found, for selected U.S. agricultural supply and marketing co-operatives, that the agency costs of debt were statistically significant. Their results indicated that a 10 per cent increase in the co-operative's debt would increase variable costs by 1.67 per cent. Featherstone and Al-Kheraiji (1995) modeled six outputs (grain, fertilizer, chemical, petroleum, feed, and other merchandise), two variable inputs (labour and other inputs) and one fixed input (fixed capacity). Bernstein and Nadiri (1993) and Hossain and Jain (2001) investigated the effect of agency costs of debt on the total factor productivity of the U.S. manufacturing industry using a variable profit function. Bernstein and Nadiri (1993) found that agency costs of debt reduced the total factor productivity of the U.S manufacturing industry by 3.3 per cent. According to Hossain and Jain (2001) agency costs accounted for about 12.25 per cent of reduction in productivity growth in the U.S. food manufacturing industry. However, the issue of agency costs of debt has not been addressed in the context of Canadian co-operative agribusiness firms. Table 2-1 summarizes data used by the four studies that empirically measure agency costs of debt using production theory.

2.3 Conceptual Model

2.3.1 Agency Problems

The analytical underpinnings of the study of agency problems are provided by the principal agent theory (Varian, 1992; Jensen and Meckling, 1976; Ross, 1973) and the theory of incentives (Alchian and Demsetz, 1972; Laffont and Martimort, 2002a; Haubrich, 1994). Principal agent theory is concerned with situations where the principal requires the agent to undertake an action on the principal's behalf (Jensen and Meckling, 1976; Ross, 1973). The financial theory of principal agent problems relates to the relationship between the capital providers (i.e., the principal) of the firm and the management of the firm (i.e., the agent). Principal agent problems occur in situations where agents may use information asymmetry to their advantage (Varian, 1992; Laffont and Tirole, 1988; Rogerson, 1985; Alvi, 1997; Rogerson, 1985; Jewitt, 1988; Holmström, 1979; Barnea et al., 1985).

The principal agent problem is that the principal cannot [perfectly] monitor the agent's work, as the agent's effort may be private information. Ideally, in a co-operative business framework, the board of directors[3] observes only the co-operative's profit and producers'/consumers' surplus and rewards the manager according to a wage function – i.e., wage is a function of the agent's performance. On the other hand, the manager makes effort level decisions that are unobservable[4].

Furthermore, the absence of share ownership by the firm manager, which is the case in co-operative firms, may provide an incentive to expend less effort than had the manager been the sole owner of the firm. It should also be noted that as profits of the co-operative increase, more could be given back to the members as patronage payments.

2.3.2 The Financial Theory of Agency Costs

The financial theory of agency costs can be considered as an application/extension of the economic theory of agency contractual relationships in finance. In finance, agency problems are closely related to the situation where the capital provider and the manager sign a contract that specifies what the manager does with the resources and how the returns are divided between the manager and the capital providers (Coase, 1937; Jensen and Meckling, 1976; Fama, 1980; Fama and Jensen, 1983; Grossman and Hart, 1986). Given contractual agreements, agency problems arise when the manager potentially does not represent the best interest of the capital provider since the objectives of the managers are not always identical to those of the capital provider. The principal-agent literature (Ross, 1973; Jensen and Meckling, 1976; Fama, 1980; Fama and Jensen, 1983; Jensen, 1986) has addressed the design of firm's capital structure and the compensation of managers (Royer, 1999) in order to mitigate agency costs. For example, Jensen (1986) stated that debt should create value if it directly reduces over-investment when the firm faces potentially high agency costs of free cash flows.

The agency costs that arise because of contractual relationships are the sum of i) the monitoring costs by the principal, ii) the bonding costs by the agent and iii) the residual loss (Jensen and Meckling, 1976). Monitoring costs are the expenditures by the principal in order to follow-up on the agent's action. On the other hand, bonding costs refer to expenditures incurred by the agent in order to assure the principal that he/she will behave honestly. Bonding costs include things like contractual guarantees to have the financial accounts audited by a public account, explicit bonding against malfeasance on the part of the managers, and contractual limitations on the manager's decision-making power. The residual loss occurs when it is impossible for the agent or the principal to fully guarantee or to be guaranteed that the agent will not deviate from the optimal decisions made in the principal's interest.

Within the framework of Jensen and Meckling's (1979) discussion, it should be noted that monitoring and bonding costs in a co-operative are the same as in a corporation of similar size. However, the incentive to enforce contracts may be lacking.

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[3] The board of directors is elected by members of the co-operative to make policy and oversee the co-operative's business affairs.

[4] In both economic and financial agency theory, the unobservability of the agent's effort is the core of the incentive problem.

Members may have less incentive to effectively enforce a contract since the property rights of the members are attenuated.

Many co-operative researchers suggest that the property rights and governance structure of co-operatives result in a set of problems that arise from separation of ownership and management (Nilsson 1998b, Vitaliano 1983; Harte 1997). In addition to the IOF-like agency problems, the co-operative firm has some unique inherent investment-related incentive problems related to (i) the horizon problem; (ii) the common ownership problem (or the free-rider problem); (iii) the portfolio problem; (iv) the decision-making problem (or the influence costs problem); and (v) the follow-up or control problem (Cook, 1995; Fulton, 2001; Nilsson, 2001).

When property rights are collective or unassigned then free rider behaviour may arise (Kyriakopoulos, 1998). Co-operatives usually adopt open membership which simply means that a new member does not have to contribute to the value of co-operative assets. Thus benefits from investments can be captured only over the time of membership/use and not over the productive life of the assets giving rise to the horizon problem (Caves and Petersen 1986). Patrons cannot acquire a portfolio of investments which reflects their risk preferences due to lack of tradability of ownership rights (Vitaliano, 1983). In contrast with IOFs, decision rights are poorly developed in co-operatives, making members' interference a necessity. Decision control cannot be exercised since shares are not tradable. Thus, members' involvement with co-operative decision control is necessary and it is demonstrated by restricting membership on the co-operative board to farmer-members only (Vitaliano 1983).

These co-operative specific agency problems may result in major equity capital constraints and excessive borrowing, where excessive borrowing may in turn lead to agency costs of debt. Their common core is the assumption that members do not bear the full impacts of their choices and actions. Nilsson (2001) argued that these co-operative specific agency problems can appear to be more or less problematic, depending on variables such as the degree of membership homogeneity, the size of members' financial contribution, the degree of contingency between members' goals and the co-operative's goals, and the degree of members' involvement with their co-operative. For example, larger costs can be engendered by conflicting interests when the membership is heterogeneous (Hansmann, 1988).

The agency problem is aggravated as the membership of co-operatives becomes more diversified in terms of farm size, product, nationality, and age (Kyriakopoulos, 1998). For example, the horizon problem appears to be stronger when farms are being sold instead of transferred to the younger generation of the same family. The structure of residual claims restricts capital growth, which is verified by empirical evidence (Fulton et al. 1995).

In summary, neoclassical economic theory states that in a perfectly competitive market, market pressure resolves the problem of incentives for profit maximization or cost minimization. Neoclassical economic theory, however, treats the firm as a 'black box'; that is, the theory predicts how the firm's production plan varies with input and output prices, but it says nothing about how this production plan comes about (Hart 1995). Neoclassical economic theory assumes that effort choices are observable. The principal-agent theory departs from this assumption by supposing that some costs are private information. In the principal agent literature, incentive becomes the central focus of the analysis where the owners of the firm try to align the objectives of the various members, such as owners, workers, supervisors, and managers (Laffont and Martimort, 2002b). Specifically, agency problems occur if the owner of the firm delegates a task to a manager who has an incentive incompatibility constraint, and the information about the manager is imperfect. When the conflicting objectives and asymmetric information (which could be moral hazard or hidden action) between the agent and the principal create problems, agency costs may arise. This issue may even be more pronounced in the case of a co-operative firm where managers of the firm may not share ownership rights. The substantial part of managerial compensation that is not equity-based has long been criticized as being weakly linked to managerial performance (Murphy, 1999). It may be that firms that expect better performance use more equity-based compensation.

2.3.3 Debt Financing and Agency Problems in Co-operatives

Suppose a stream of welfare of a member of a co-operative over time is given by W. The stream of welfare is defined as the sum of the profits of the co-operative and producer surplus. That is,

$$W = \Pi + PS \tag{2-1}$$

where W is the welfare of the co-operative member, Π is the profit of the co-operative, and PS is the producer surplus. The profit of the co-operative is defined as:

$$\Pi = PQ - \varpi x - F \tag{2-2}$$

where P is the price of the firm's output, Q is the quantity of the firm's output, ϖ is the price of the raw materials purchased by the co-operative, x is the quantity of raw materials purchased and F is fixed cost of production. The producer surplus is defined as:

$$PS = \varpi x - \int \varpi(x)dx \tag{2-3}$$

Substituting equations (2-2) and (2-3) into equation (2-1) gives:

$$W = PQ - \int \varpi(x)dx - F \tag{2-4}$$

Consider any marketing co-operative j and let W_j stands for the expected stream of members' welfare on the assets owned by the co-operative (i.e., its expected profits plus producer surplus before deduction of interest). Denote by D_j the market value of the debts of the firm; and by S_j the "value" of its equity; and by $V_j = D_j + S_j$, the "quasi" market value of all its assets or the market value of the firm. Then, $V_j = (S_j + D_j) = W_j/r_k$ and $r_k = W_j/V_j$ (average cost of capital). From the Modigliani and Miller (1958) proposition and assuming a one-period model it can be shown that:

$$\frac{W_j}{(S_j + D_j)} = \frac{W_j}{V_j} = r_k \tag{2-5}$$

Diaz-Hermelo et al. (2001) showed that the value of co-operative equity, S_j, is a function of the expected incremental value of cash patronage and dividends plus the discounted book value of equity. That is, for an individual member, the value of equity capital may be summarized as:

$$S_m = \frac{r_e\left[(S_{BV,m=0} - SR)\alpha_m\gamma_m\right]}{1 + r_m} + \frac{S_{BV,m=0}\Phi}{1 + r_m} + \frac{S_{BV,m=0}}{1 + r_m} \tag{2-6}$$

where S_m, is the value of the co-operative equity for member m at the beginning of year t, r_e, is the co-operative's return on equity in year t, $S_{BV,m=0}$ is the book value of equity for member m at the beginning of year t, SR is the amount of stock returned to members in the current period, α_m is the cash patronage payment ratio in year t, γ_m is the member's share of total business in year t, and Φ is the board determined dividend rate. Substituting equation (2-6) in (2-5) provides:

$$r_k^m = \frac{\gamma_m\left(PQ - \int w(x)dx - F\right)}{\dfrac{r_e\left[\left(S_{BV,m=0} - SR\right)\alpha_m\gamma_m\right] + S_{BV,m=0}\Phi + S_{BV,m=0}}{1 + r_m} + \gamma_m D} \qquad (2\text{-}7)$$

Suppose two scenarios where marketing co-operatives with and without debt financing but with the same cash flows under both situations, W_U and W_L, in which case the first case it is totally financed with equity capital while the second case it is highly levered. Assume that there is an equal proportionality between investment and volume of business. Assume also that the expected welfare, W_j, is the same for under both scenarios, i.e., $W_L = W_U$. Consider a farmer member doing s_L dollars worth of the farm business of the levered co-operative, yielding a fraction γ of the total business, S_L. The return from this portfolio Y_L will be a fraction γ of the income available for the members of the co-operative, which is equal to the total return less interest charge, rD_L. This portfolio worth:

$$Y_L = \gamma_L\left[PQ - \int w(x)dx - F - rD_L\right] \qquad (2\text{-}8)$$

Suppose the member of the co-operative surrender this claim, $\gamma_L S_L$, and do business of $\gamma_L[S_L + D_L)$ with the un-levered co-operative, with a proportion of $\dfrac{\gamma_L\left(S_L + D_L\right)}{S_U}$. Based on Modigliani and Miller (1958) this portfolio worth is given by:

$$Y_U = \frac{\left(S_L + D_L\right)}{S_U}\gamma_L W_U - r\gamma_L D_L = \frac{V_L}{V_U}\gamma_L W - \gamma_L rD_L \quad \text{such that} \quad \frac{\partial Y_U}{\partial V_U} < 0, \frac{\partial Y_U}{\partial V_L} > 0 \ (2\text{-}9)$$

That is, the returns from the un-levered firm is inversely related to its own capitalized value and directly related to the capitalized value of the levered firm. Substituting equations (2-4) and (2-6) into equation (2-9) we have:

$$Y_U = \frac{\left[\dfrac{\left[r_e\left(S_{BVL} - SR_L\right)\alpha_L\gamma_L\right] + S_{BVL}\Phi_L + S_{BVL}}{1 + r_m} + D_L\right]}{\left[\dfrac{\left[r_e\left(S_{BVU,m} - SR_U\right)\alpha_U\gamma_U\right] + S_{BVU}\Phi_U + S_{BVU}}{1 + r_m}\right]}\gamma_L\left(PQ - \int w(x)dx - F\right) - r\gamma_L D_L \qquad (2\text{-}10)$$

where $\dfrac{\partial Y_U}{\partial \gamma_U} = \dfrac{\partial Y_U \partial V_U}{\partial V_U \partial \gamma_U} < 0$, $\dfrac{\partial Y_U}{\partial \alpha_U} = \dfrac{\partial Y_U \partial V_U}{\partial V_U \partial \alpha_U} < 0$, $\dfrac{\partial Y_U}{\partial \Phi_U} = \dfrac{\partial Y_U \partial V_U}{\partial V_U \partial \Phi_U} < 0$, suggesting that the unlevered firm's return is inversely related to the cash patronage payment ratio, α_U, the member's share of the total business, γ_U, and the board determined dividend rate, Φ_U.

Suppose that $V_L > V_U$ and $W_L = W_U$. As long as $V_L > V_U$, from equation (2-9), we must have $Y_u > Y_L$, so that it pays a member of the levered marketing co-operative who is interested in maximizing returns, Y, to stop patronizing and redeem equity capital, and thereby depressing V_L; and patronize the levered co-operative, thereby increasing V_U. The decision by the member to withdraw his/her claim from the co-operative is a form of partial takeover or liquidation which deprives management of control over assets (Fama and Jansen, 1983). This follows from the fact that co-operative residual claims are partially redeemable on demand (Fama and Jensen, 1983) based on a predetermined policy. The members of a co-operative organization can surrender their claims by ceasing to patronize the organization (Vitaliano 1983).

In general, based on results from equations (2-8) and (2-10), members who are interested in higher cash patronage refunds may vote for higher values of SR, Φ, and/or α. This rewards current member business volume at the expense of capital accumulation for growth and redemptions. On the other hand, co-operative management whose objective is capital accumulation for growth may be interested to maintain more equity capital in the co-operative through decrease in cash patronage and equity redemption. Thus, the management may be interested to set SR, Φ, and α as low as possible. The decrease in cash patronage may result in perceiving a decrease in the net price of the raw materials sold to the co-operative which may reduce members' raw material supply to the co-operative. Board members are torn between requests from redemption by members and fund required to support business growth interest of the management. As individual member pressure the board for cash patronage refunds, member patronage may decline and hence the cash flows of the levered co-operative may decline. If cash from operations is distributed back to the members, the management may resort to using more debt to finance investment in assets.

Unless agency problems are resolved they may lead to suboptimal allocation of resources within the organization resulting in increased costs of production. To empirically investigate the impacts of agency costs of debt on resource allocation, the neo-classical theory of the firm is adopted and discussed below.

2.3.4 Modeling Agency Costs of Debt

In the above models, before production is actually carried out and the effort decision is made, the production process needs to be financed, suggesting that the financial structure of the firm has a potential impact on the output level (Brander and Spencer, 1989). Assuming the existence of a significant conflict of interest between capital providers and managers that affects investment incentives, Kim and Maksimovic (1990) proposed a two-period (i.e., time t_0 and time t_1) agency model that relates the financial structure and the production decisions of a firm facing uncertainty concerning the level of demand for output. Accordingly, at time t_0 the firm's equity holders choose the financial structure by deciding how much debt to issue. In addition, at time t_0, they also decide on the level of observable capital (i.e., capacity) and purchases of unobservable managerial efforts (or services). At time t_1, taking the t_0 level of capacity, level of effort and level of debt as given, the firm decides on the level of variable inputs used in production process. Since the input decision at time t_1 is conditioned on the choices made at time t_0, the input decision at time t_0 will affect the optimal input mix at time t_1. Following Kim and Maksimovic (1990), at time t_1 the co-operative agribusiness firm's problem is to optimize[5] the following:

$$\min_x \left\{ w^i.x^i + w^j x^j : y \leq f(k,e,x^i,x^j) \right\}, e,k \in \arg\max_{e,k} E(S \mid S \geq 0) \} \qquad (2\text{-}11)$$

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[5] Assuming that the level of co-operative processor output is given, the profit or the welfare maximization problem for the co-operative is equivalent to minimizing the short-run total cost function, and hence, the cost function approach may be appropriate.

where k and e are the levels of capacity and managerial efforts chosen at time t_0, x_j and w_j are the quantity and the price of raw material purchased from the co-operative members, respectively, x_i and w_i are vectors of other variable input quantities and unit prices, respectively, y is the quantity of output, S is the value of equity, and E is the expectation operator. The production function $y \leq f(k, e, x^i, x^j)$ is assumed to be increasing in k, e, x_j and x_i (Brander and Spencer, 1989). Economic theory of agency cost also suggests that output increases with the level of managerial or workers' service/effort. On the other hand, financial theory of agency costs suggests that the level of managerial service likely declines/increases with the level of debt financing. The effect that the level of debt has on managerial efforts can implicitly be defined as (Brander and Spencer, 1989):

$$e = \psi(D), \qquad e_D \overset{>}{\underset{<}{-}} 0 \tag{2-12}$$

In terms of the agency costs theory, $e_D < 0$ implies higher probabilities of lower effort exertion. For example, if debt serves as a mechanism against agency costs of free cash flows, $e_D > 0$ implies higher probabilities of higher effort exertion.

The above results may be summarized in terms of alternative hypotheses. The over-investment hypothesis suggests that when managerial investment decisions reflect their personal interests rather than those of investors, agency costs of debt result due to the difficulty financiers have in assuring that their funds are not expropriated or wasted on unattractive projects. While stockholders want managers to maximize the value of their stocks, managers might have a personal agenda and they derive utility from consuming perks. In this case, $e_D < 0$. Conversely, the control hypothesis suggests that in the presence of large free cash flows, debt issues will have positive control effects ($e_D > 0$). That is, debt provides a shield against the agency costs of free cash flow by reducing free cash flow and constraining management. As debt forces the firm to pay out the excessive cash flow, it decreases the free cash flow which is at managers' discretion and thus in danger of being sub-optimally invested.

From an empirical point of view the agency costs of debt are not easily tractable and testable. In an attempt to deal with an intractable problem, agency costs of debt are defined as representing a shift in the production function through their effect on managerial efforts. Thus, there exists a stable relationship between output, inputs and pre-existing debt level. Taking into consideration that the level of effort is determined by the debt level (Brander and Spencer, 1989), the solution to the problem in equation (2-11) will be a set of factor demands of the form

$$x_i = x_i(w^i, w^j, y; k, D) \qquad \forall_i \quad \in \quad (1,2,\ldots,n) \tag{2-13}$$

where D is the lagged debt, x_i is the i-th non-farm variable inputs, x_j is the raw material from members. If these factor demands (derived using Shepherd's Lemma) are substituted back into the factor cost function, c(.), a short-run minimum value function is obtained:

$$SVC = c(w^i, w^j, k, y, D) = \min_x \begin{Bmatrix} w^i.x^i + w^j.x^j : y \leq f(k, e, x^i, x^j) \\ e, k \in \arg\max_{e,k} E(S \mid S \geq 0) \end{Bmatrix}. \tag{2-14}$$

In this model, while the firm's cost c(.) is publicly observable, e is a private information of the manager. Thus, the objective of the co-operative agribusiness firm can be stated as minimizing short-run dual costs conditional on a given level of output, debt and stock of capital.

Maintaining the assumptions that $f(k,e,x^i,x^j)$ satisfies the standard properties in x of production functions and that the input requirement set is nonempty is sufficient to prove the existence of a well-defined short-run variable-cost function satisfying the properties of cost functions in terms of x_i, x_j and y (Chambers, 1988). Since k and D are already predetermined in period t_l when the other variable inputs are chosen, the quantities of debt and capacity are exogenous to the short-run variable cost model. Therefore, this cost function can be defined as the minimum cost of producing a given level of output (where output is assumed to be exogenously determined) as a function of variable input prices, capacity, and lagged debt level.

When exerting e, the manager reduces the firm's costs of production but incurs a disutility. To measure the agency costs related to debt capital, the derivative of the short-run cost with respect to debt is used (Kim and Maksimovic, 1990); that is,

$$AC_i = \frac{\partial c_i(w^i,w^j,k,y,D)}{\partial D_i} \tag{2-15}$$

where AC_i is the agency cost for the i-th co-operative agribusiness firm. Agency costs exist if AC_i is positive. When the cost function and the production function are both differentiable, a unique relationship exists between the agency costs and the marginal cost, "shirking effect"[6], and the effect of debt on managerial efforts. Consider the Lagrangian:

$$\ell = w^i.x^i + w^j.x^j + \lambda\left[y - f(x^i,x^j,k,e)\right] \tag{2-16}$$

where λ is a Lagrangian multiplier. The envelope theorem may be applied as follows:

$$\frac{\partial c(w^i,w^j,y,k,D)}{\partial D} = -\frac{\lambda \partial f(x^i,x^j,k,e)}{\partial D} \tag{2-17}$$

Recalling that the optimal value of the Lagrangian multiplier for the cost minimization problem is marginal cost gives:

$$\frac{\partial c(w^i,w^j,y,k,D)}{\partial D} = -\left(\frac{\partial C}{\partial y}\right)\left(\frac{\partial f(x^i,x^j,k,e)}{\partial e(k,D)}\right)\left(\frac{\partial e(k,D)}{\partial D}\right) \tag{2-18}$$

where $\left(\frac{\partial C}{\partial y}\right)$ is the marginal cost of production, $\left(\frac{\partial f(x^i,x^j,k,e)}{\partial e(k,D)}\right)$ is the "shirking" effect if the agent is shirking, which may result in inefficiency of resource use, and $\left(\frac{\partial e(k,D)}{\partial D}\right)$ is the effect of debt on the level of effort. In this formulation the term $\left(\frac{\partial f(x^i,x^j,k,e)}{\partial e(k,D)}\right)$ is always greater than zero, the term $\left(\frac{\partial e(k,D)}{\partial D}\right)$ is greater or equal to zero, and the term $\left(\frac{\partial C}{\partial y}\right)$ is greater than zero if it represents the output supply function. Thus, for an upward rising marginal cost function, agency costs of debt exist if the term $\left(\frac{\partial e(k,D)}{\partial D}\right)$ is less than zero. In equation (2-18), only marginal cost of production is measurable since the managerial effort is unobservable. Yet, managerial effort may be measured or surrogated by productive efficiency.

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[6] The agent is said to shirk if he/she chooses not to undertake efficient actions measured in terms of production performance. Shirking effect, or inefficient action effect, is most likely to occur when contracts do not satisfy the incentive compatibility constraint. The constraint is satisfied when the contract spells out incentives that cause the agent to take efficient actions.

Finally, the degree of economic importance of agency costs can be derived by investigating the elasticity of input misallocation caused by agency costs as:

$$\varepsilon_{D_i} = \left(\frac{\partial \ln c_i(w^i, w^j, k, y, D)}{\partial \ln D_i}\right) = -\left(\frac{\partial \ln C}{\partial \ln y}\right)\left(\frac{\partial \ln f(x^i, x^j, k, e)}{\partial \ln e(k,D)}\right)\left(\frac{\partial \ln e(k,D)}{\partial \ln D}\right) \qquad (2\text{-}19)$$

If there are agency costs of debt, $\varepsilon_{Di} > 0$. If debt serves as a control mechanism to mitigate the agency costs of free cash flows, $\varepsilon_{Di} \leq 0$.

2.3.5 Does Supply Management Matter?

Supply management is a system involving production quotas and producer marketing boards that regulate and stabilize both the supply and prices Canadian farmers receive for their poultry, turkey, eggs, and milk products. The supply management system involves control of imports, production, and pricing. By using a costs-of-production (COP) formula, the provincial eggs boards set prices. For chicken, turkey and hatching eggs the boards currently negotiate prices with processors, taking into account market conditions and input costs. As some agricultural co-operatives are operating in supply-managed industries, a study of the impact of supply management on cost efficiency would be a valuable guide to policy makers in this regard.

An important issue is whether the behaviour of the marketing co-operative agribusiness firm is different under regulatory constraints on raw material supplies and prices. A policy of limiting total production through the allocation of marketing rights, or quotas, to producers adds a constraint in the optimising behaviour of producers and processors in the regulated industry.

In Canada, most poultry processing plants buy, process and sell both chicken and turkeys under a regulated industry situation. In the case of the poultry industry, the national producers' agency for turkey, in consultation with the processors (both co-operatives and IOFs) at the national level, sets the country's production requirements which are subsequently divided among provincial producer marketing boards. For chicken, the national production requirement is determined through a "bottom-up" approach whereby each provincial commodity board through consultation with their processors determines provincial level market requirements (Agriculture and Agri-Food Canada, 2004).

In a situation where there are many processing firms and/or raw material is not rationed, supply management may not impose a constraint on individual processing firms. However, if the raw material (i.e, birds) is rationed[7], processors may not operate on their poultry input demand functions and observed prices and quantity demanded will not lie on this function (Rude, 1992). As a result of supply management, processors face a reduced supply of raw materials (Schmitz et al., 2002). Furthermore, with increasing market concentration[8] and vertical integration of firms, processors may face a significant constraint on raw materials. The existence of producer level production quota, along with market concentration and vertical integration[9], may create difficulties for processors in acquiring raw materials as dictated by their input demand curves. The basic argument underlying this analysis is that raw material is a binding constraint for processors.

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[7] Volume and prices are established prior to undertaking production and are common knowledge throughout the industry. In many cases, these prices are negotiated or determined in consultation with processors either separately or jointly in a province.

According to Harrison and Rude (2004), for example, the four-firm concentration ratio for the Canadian chicken industry was 61 per cent in 2001. In 2003, when considering companies that slaughtered poultry, five companies (Flamingo Foods, Maple Leaf Poultry, Lilydale Poultry Co-operative, Maple Lodge Farms and Groupe Dorchester/St. Damase) accounted for fifty five percent of the chickens slaughtered in Canada (Agriculture and Agri-Foods Canada, 2003). Including the next five largest companies brought the total share of the ten largest primary poultry processing companies up to eighty one percent.

Over the last decade, the poultry processing sector in Canada has experienced a significant rationalization through corporate re-organization, and the introduction of multi-plants. For example, the number of poultry processing establishments has declined from about 117 in 1990 to 89 in 1999. This rationalization was accompanied by a considerable investment in plant and equipment (CANSIM SERIES M101785). Eighty percent of poultry processing is done by twenty two percent of the plants.

In Alberta, the poultry processing sector is comprised of a few large multi-plant co-operative (e.g. Lilydale with three establishments) and investor-owned (e.g., Maple Leaf Poultry with one establishment) firms. For a co-operative processing firm, raw material may be a binding constraint if it is coming from its member patrons only – due to vertical integration and supply management. Thus, the behavioural objective of such a co-operative agribusiness firm will be to maximize short-run members' restricted welfare or minimize restricted variable costs conditional on a given level of raw material, output, debt and capital stock. The restricted cost function for the processors in the regulated industry is then given as:

$$SVC = c(w^i, \bar{x}^j, k, y, D) = \min_x \left\{ \begin{matrix} w^i.x^i + w^j\bar{x}^j : y \leq f\left(k, e, x^i, \bar{x}^j\right) \\ e, k \in \arg\max_{e,k} E\left(S \mid S \geq 0\right) \end{matrix} \right\}. \qquad (2\text{-}20)$$

where $\bar{x}^j$ is the supply managed raw material. In this case, it is convenient to assume that the constraint on the raw material is always binding so that all raw materials available are utilized and the fixed raw material does not necessarily minimize costs. However, Shepherd's Lemma can be invoked to derive shadow prices (values) for fixed (supply managed) inputs in restricted cost functions. Then, the raw material input demand function can be solved from the derivative result.

For the restricted short-run cost function, the degree of economic importance of agency costs can be obtained by investigating the elasticity of input misallocation caused by agency costs of debt as:

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[8] In a concentrated market, without supply management, individual firms could have a much bigger impact on raw material price.

[9] Producers/marketing co-operative may be considered as a form of vertical integration.

$$\varepsilon^{S}_{Di} = \left(\frac{\partial \ln c_i(w^i, \bar{x}^j, k, y, D)}{\partial \ln D_i}\right) = -\left(\frac{\partial \ln C}{\partial \ln y}\right)\left(\frac{\partial \ln f(x^i, \bar{x}^j, k, e)}{\partial \ln e(k, D)}\right)\left(\frac{\partial \ln e(k, D)}{\partial \ln D}\right) \quad (2\text{-}21)$$

By invoking the Le Chatelier-Samuelson principle, more restrictions make choice variables less responsive to the changes in exogenous variable (Chambers, 1988). This suggests that the degree of economic importance of agency costs may be different for firms operating in regulated and unregulated industries. This can be shown by investigating the elasticity of input misallocation that is caused by agency costs of debt as:

$$\left(\frac{\partial \ln f(x^i, x^j, k, e)}{\partial \ln e(k, D)}\right)\left(\frac{\partial \ln e(k, D)}{\partial \ln D}\right) \geq \left(\frac{\partial \ln f(x^i, \bar{x}^j, k, e)}{\partial \ln e(k, D)}\right)\left(\frac{\partial \ln e(k, D)}{\partial \ln D}\right) \quad (2\text{-}22)$$

which implies that $\varepsilon_{Di} \geq \varepsilon^{S}_{Di}$. Thus, agency costs of debt may be less pronounced under supply management. The above condition can also be shown using a constrained profit maximization problem. Assuming the firm is using only raw materials as variable costs, for profit maximizing firm this can be shown as follows:

$$\pi = Py - w^j x^j - F \quad (2\text{-}23)$$

Differentiating the first order condition with respect to e gives the following:

$$\frac{\partial^2 f}{\partial x^j \partial x^j} dx^j + \frac{\partial^2 f}{\partial x^j \partial e} de = 0 \quad (2\text{-}24)$$

From the profit function the optimal supply function may be defined as $Q^* = f(x_j, e, k)$, and it can also be shown that :

$$\frac{\partial y^*}{\partial e} = \frac{\partial f dx^j}{\partial x^j de} + \frac{\partial f}{\partial e} \quad (2\text{-}25)$$

substituting (2-14) into (2-15)

$$\frac{\partial y^*}{\partial e} = -\left(\frac{\partial f}{\partial x^j}\right)\left(\frac{\dfrac{\partial^2 f}{\partial x^j \partial e}}{\dfrac{\partial^2 f}{\partial x^j \partial x^j}}\right) + \frac{\partial f}{\partial e} \quad (2\text{-}26)$$

By the second order condition, $\frac{\partial^2 f}{\partial x^j \partial x^j} \leq 0$. Note that it can be assumed that $\frac{\partial^2 f}{\partial x^j \partial e} > 0$ since an increase in effort level would raise the marginal productivity of the raw materials. This is plausible under many scenarios, but does not necessarily hold. Now, if the level of raw material is restricted by the quota system the above equation reduces to: $\frac{\partial y^{S*}}{\partial e} = \frac{\partial f}{\partial e}$ suggesting that $\frac{\partial y^{S*}}{\partial e} \leq \frac{\partial y^*}{\partial e}$, where y^{s*} is processor's optimal output under supply management policy.

Further to the above analyses, if we assume a fixed proportion production technology (Royer and Bhuyan, 1995) between the raw materials supplied by members and the output of the processing co-operative firms, agency costs may be zero since $\partial y / \partial e = 0$. Theoretically, it can be argued that the regulatory environment matters as to whether the financial structure affects the cost efficiency of co-operative agribusiness processing firms or not. This proposition is explored using empirical analysis in this section. Intuitively, Canada's supply management system along with vertical integration may serve as a monitoring system. In this situation, the board of directors is able to prescribe the optimal output policy in an ex ante sense and the manager implements it faithfully, presumably because the board of directors would be able to observe whether the firm deviated from that policy. Firm managers may not indulge themselves in input misallocation because the level of output is determined mainly by the level of raw material (i.e., binding constraint) used. Management of the processing firms is likely to increase their selling prices and is likely to adopt cost minimizing means of using other variable and fixed inputs.

The provincial marketing boards control/set input prices (Schmitz et al., 2002) or, alternatively, producer prices. Differences in the prices various processing firms charge is, however, less likely to be significant since they all use inputs that are regulated and they all sell in closely related distribution channels. As such, prices of processor's output may not be a choice variable for management, particularly as the retail sector is also heavily concentrated (Fulton and Tang, 1999). Thus, to obtain higher gross profit margins, management of the processing firms in supply-managed industry may have to adopt more cost efficient ways of using other inputs. In agency cost theory, this managerial disciplining mechanism may result in lower probabilities of exerting lower efforts, or alternatively higher probabilities of exerting higher effort levels.

The above argument about the fixed proportion relationship between inputs and outputs may be extended to retailing co-operatives where the major activity involves buying products for transformation and re-sale. Intuitively, because the level of sales is directly related to the volume of goods bought for re-sale, the co-operative's board of directors may have efficient control over the level of goods bought for wholesaling/retailing, M_t, which constitutes the major share of the costs of production. Put differently, since the supply co-operatives have a clear idea of their own needs, monitoring the level of output would be more efficient. Thus, there may be a lower probability of information asymmetry and managers are less likely to undertake projects that increase their personal benefits.

Furthermore, as the transactions relating to labour and other inputs make up a relatively small proportion of the total costs of production, the impact of debt on resource misallocation is relatively low. Management has to strive to increase efficiency of labour use and other variable inputs in order to minimize costs. For the retailing/wholesaling co-operative, the measure of agency costs of debt may be defined as follows:

$$\frac{\partial c(w^i, V, k, D)}{\partial D} = -\left(\frac{\partial C}{\partial V}\right)\left(\frac{\partial g(x^i, k, e)}{\partial e(k, D)}\right)\left(\frac{\partial e(k, D)}{\partial D}\right) \qquad (2\text{-}27)$$

Thus, in situations where the board has efficient control over the level of output produced or service provided, it can be argued that past debt leverage and current value-added for retailing/wholesaling co-operative firms will be negligible (i.e., $\left(\frac{\partial e(k, D)}{\partial D}\right) \approx 0$) or close to zero. This is because the management exerts more effort to minimize costs of labour input, other variable inputs and fixed inputs.

2.3.6 Does Co-operative Governance or Structure Matter?

Corporate governance refers to the mechanisms and process by which corporations are governed. That is, it is a process by which owners of the firm attempt to minimize agency (Jensen and Meckling, 1976) and transaction costs (Coase, 1937) associated with doing business within a firm. Hart (1995) defines corporate governance as follows:

> *Corporate governance issues arise in an organization whenever two conditions are present. First there is an agency problem, or conflict of interest, involving members of the organization – these might be owners, managers, workers or consumers. Second, transaction costs are such that this agency problem cannot be dealt with through a contract.* (Hart, 1995)

Shleifer and Vishny (1997) describe corporate governance as follows:

> *Corporate governance deals with the ways in which suppliers of finance to corporations assure themselves of getting a stream of returns on their investment. How do the suppliers of finance get managers to return some of the profits to them? How do they make sure that managers do not steal the capital they supply or divert it to other uses? How do suppliers of finance control managers?* (Shleifer and Vishny, 1997: p 737)

Thus, in the absence of complete contracts and where agency costs are present corporate governance does have a role in the success of a firm. In general, managerial interests may prevail when governance mechanisms are weak, allowing managers a significant amount of autonomy in making strategic decisions. If the board of directors controls managerial autonomy, or if other strong governance mechanisms are used, the firm's outcome will approach that desired by the member patrons.

The argument in this section is that whether a co-operative is federated or centralized (Figure 2-1) matters in terms of the degree of agency costs of debt. By definition a federated co-operative is a co-operative of co-operatives where the members of the federative co-operative are themselves local co-operatives (Figure 2-1). The federated co-operative is a supplier of all important goods and services to local co-operatives. Federated co-operatives purchase farm input supplies in bulk and transform for resale to member co-operatives, who then resell them to their farmer-members in order to maximize the welfare of their members (e.g., farmers). In order to assist the local co-operatives in being more profitable, federated co-operatives may sell supplies to them at lower prices. At the other end, the objective of the local retail co-operatives is to maximize the welfare of the individual members (i.e., producers) by providing supplies at lower prices and/or by buying farm products delivered for marketing at higher prices. In the centralized organizational structure, decision making authority is retained at higher managerial levels. However, in a decentralized organizational structure, decision making authority moves down to the member co-operatives in the firm which have the most direct and frequent contact with member patrons.

The potential impact of the corporate governance system may be seen through an assessment of the reliance of "members" on the performance of the co-operative in terms of the impact on their own welfare. In the case of the centralized co-operative, members are individual farmers or business owners. Their welfare and viability are largely determined by the performance of their own businesses, as patronage from the co-operative represents a relatively small proportion of total income.

In contrast, the members of federated co-operatives are themselves co-operatives. Their livelihood depends on profits earned by retailing goods and services to their individual members (i.e., farmers or business owners). The success of these member co-operatives is very much dependent on the efficiency of the federated co-operative. Any inefficiency at the federated co-operative level is transferred, through higher prices paid for goods and services, down to individual member co-operatives.

As the central element of the member co-operatives' control in the federated co-operative, the board of directors of the federated co-operative is responsible for the governance - directing and controlling- of their organization in order to efficiently respond to individual local co-operative demand. Given the decentralized nature of the federated co-operative structure, in order to ensure survival of the individual member co-operatives, they will demand efficient and effective decision making authority at the board level by taking into account the optimal balance between the business and association incentives of the federated co-operative. Thus, it can be argued that if there is effective/efficient co-operative governance, the altered managerial incentive effect of debt leveraging is minimal under the federated co-operative scenario. Given the agency cost theory, effective corporate governance may lead to higher probability of exerting higher efforts.

2.4 Empirical Model

In applied production analysis selecting a functional form for the cost or profit function is an important step in assessing the characteristics of a technology (Ivaldi et al, 1996). In empirical cost function studies the most commonly used functional forms are the Translog (Christensen et al 1973), generalized Leontief, Fourier (Gallant, 1981), generalized Cobb-Douglas and Cobb-Douglas forms. One of the restrictions with the Cobb-Douglas specification is that it imposes the condition of a unitary elasticity of substitution among inputs, *a priori*. Rather than imposing such restrictions at the outset, it is preferable to test these within the framework of a more flexible cost function specification. To avoid the shortcomings inherent in the Cobb-Douglas specification, most cost and profit function studies incorporate more flexible functional forms such as the translog or generalized Leontief functions. A further advantage of using flexible cost functions is that they yield direct estimates of the various Allen-Uzawa elasticities of substitution. These parameters are important in describing the pattern and degree of substitutability and complementarity among the factors of production. Furthermore, in cost models, the effect of debt on the demand for inputs can be directly estimated. If the effect is positive, debt is input-using; if it is negative, debt is input-saving. Although studies have favored the use of flexible functional forms (e.g., Diewert 1971), the question of which flexible functional function to use is an empirical one. In this study, the Translog cost function that incorporates the debt level as a "*shift-variable*"[10] is proposed for use, as follows:

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[10] In traditional analyses of production and performance, decisions on *real* economic variables are kept separate from financial decisions. However, recent research has shown that *real* and financial decisions of firms may be interconnected due to the existence of asymmetric information, information costs and the consequent frictions in capital markets (Hossain and Jain, 2001). In this study, the potential effect of debt on real economic decisions is incorporated as a shift variable.

$$\begin{aligned}\ln SVC_t = {} & \alpha_0 + \beta_T T + \beta_y \ln y_{it} + \sum \beta_j \ln w_{jt} + \beta_k \ln k_{it} + \beta_D \ln D_{t-1} \\ & + \frac{1}{2}\left[\beta_{yy}(\ln y_t)^2 + \beta_{kk}(\ln k_t)^2 + \sum\sum \beta_{ij} \ln w_{it} \ln w_{jt} + \beta_{DD}(\ln D_{t-1})^2 + \beta_{TT} T^2\right] \\ & + \sum \beta_{jy} \ln y_t \ln w_{jt} + \beta_{yk} \ln y_t \ln k_t + \beta_{yD} \ln D_{t-1} \ln y_t + \sum \beta_{jk} \ln w_{jt} \ln k_t \\ & + \sum_j \beta_{jD} \ln w_{jt} \ln D_{t-1} + \beta_{kD} \ln k_t \ln D_{t-1} + \sum \beta_{jT} \ln w_{jt} \ln T_t + \varepsilon_t \end{aligned} \tag{2-28}$$

where SVC_t is the observed short-run variable cost in the t-th time period, y_{it} represents output in the t-th time period, w_{jt} is the price of the j-th variable input[11] in the t-th time period, D_{t-1} is lagged debt in the t-1-th period, k_t is is the level of quasi-fixed capital stock in the t-th period, T is time included to capture variation in technology over time, β's are parameters to be estimated, and ε_{it} is a stochastic term.

The effect of agency costs of debt on total variable cost and input allocation can be measured and tested using the parameters β_D, β_{DD}, β_{yD}, β_{kD}, and β_{jD}. For the Translog cost functional form, the economic importance of principal-agent problems can be assessed by estimating the agency costs of debt:

$$AC_t = \frac{SVC_t}{D_{t-1}}\left(\beta_D + \beta_{DD} \ln D_{t-1} + \beta_{yD} \ln y_t + \sum_j \beta_{jD} \ln w_{jt} + \beta_{kD} \ln k_t\right) \tag{2-29}$$

Debt shifts the total variable cost curve of the co-operative agribusiness firms if the estimates of β_D and β_{DD} are statistically significant. This effect of indebtedness is defined as the "neutral" effect (Kim and Maksimovic, 1990) or "cost-neutral indebtedness" since the cost curve is not biased towards any input share (Chambers, 1988). Cost-neutral indebtedness means that cost-minimizing input ratios are independent of the level of debt. If the debt is not cost-neutral, debt shows a greater percentage adjustment in one input than in another resulting in a bias effect of debt; that is, debt changes cost-minimizing input ratios. Therefore, debt is said to be unbiased (share neutral) if it leaves the relative cost shares undisturbed; that is,

$$\frac{\partial}{\partial D} \ln\left[\frac{S_i(w,y,k,D)}{S_j(w,y,k,D)}\right] = 0 \tag{2-30}$$

Cost shares are independent of the level of debt if indebtedness is share neutral. If indebtedness has a biased effect it alters the input allocation of the co-operative firms. Indebtedness is said to be input –j using if:

$$\frac{\partial \ln S_i(w,y,k,D)}{\partial D} > 0 \tag{2-31}$$

and input –j saving if

$$\frac{\partial \ln S_i(w,y,k,D)}{\partial D} < 0 \tag{2-32}$$

From the Translog cost function, this can be determined by testing the significance for the estimates of the parameters β_{jD}. Debt is said to be j-th input biased, if β_{jD} is statistically significant. In sum, agency costs do not exist if there are neither neutral nor biased effects of debt.

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[11] Note that for firms in a supply managed industry raw material price is replaced by raw material quantity.

2.5 Data Description

The empirical model is estimated using time-series data for five case co-operative agribusiness firms: Lilydale Foods (LF), Alberta Honey Producers (AHP) Co-operative, Federated Co-operative Limited (FLC), Saskatchewan Wheat Pool (SWP) and United Farmers of Alberta (UFA).

> *[Currently], Lilydale Foods is the largest poultry [processing co-operative] in the country. Lilydale operates eight processing plants, five hatcheries, six corporate farms, one egg plant and one manufacturing plant. Lilydale generates hundreds of products, which are sold throughout Canada as well as to an international marketplace.* (Lilydale Foods, 2004).

FCL is owned by more than 300 retail co-operatives as their own central wholesaling, manufacturing and administrative organization. FCL is involved in business operations such as petroleum retailing, grocery, family fashions, feed, food, forest products, and hardware and building products. Member co-operatives and FCL are known as the co-operative retailing system in Western Canada. FCL is selected to represent a case of federated co-operative type.

The AHP Co-operative processes and packages pure natural honey and honey related products. The Alberta Honey Producers Co-operative is also involved in value-added operations to process and market producers' wax. Alberta Honey Producers also contains a retail outlet which, of course, sells honey. The AHP has the largest beekeeping supplies retail outlet in Western Canada.

SWP is a Canadian publicly traded agri-business 'co-operative' created by Saskatchewan farmers in 1924, and is a leading service provider in Saskatchewan. The Pool's primary businesses are grain handling and marketing - supported by one of western Canada's largest agri-products retail marketing operations. The Pool is involved in agri-food processing and maintains feed processing and hog production operations.

Finally, UFA is a member owned Alberta-based co-operative that offers a wide selection of general farm supplies, building materials, consumer goods, fuel and petroleum products. It has a network of 34 farm supply stores and over 110 petroleum outlets strategically located throughout Alberta.

This study is unique in that firm level disaggregated data are used to measure and compare agency costs of debt across different regulatory environments. For this study, LF is an example of a firm facing regulated raw material supplies/prices for processing. For all co-operatives, data on sales of co-operative output, costs of labour, costs of raw material inputs, costs of other variable inputs, depreciation, capital investment, property, buildings, equipment, long-term debt, are obtained from annual reports of the co-operatives. The long-term debt is zero over the period 1997-2001 for FCL. To avoid problem related to taking logarithm of zero the value 0.0001 is added to the debt series. The retail trade industry hourly wage rate is obtained from Statistics Canada Database (CANSIM[12]- L180481) and other sources. The consumer price index for transportation (as a proxy for marketing services) (CANSIM-P200174) and for utilities (water, fuel and electricity) (CANSIM-P200089) are obtained from CANSIM.

For LF and AHP, data for prices of raw materials are obtained from the Annual Survey of Manufacturers (ASM) by dividing the aggregate value of commodity shipped by quantity shipped for the industry. Raw materials price indexes for grains and others are obtained from CANSIM (Table Number: 3300001). For LF and AHP, wage rates are obtained from ASM by dividing total wages of production workers by hours worked by production workers for both industries. Raw material prices for honey are obtained from CANSIM II (SERIES V170371) by dividing the value of farm production by quantity of honey produced. Output prices of processed poultry are obtained from ASM and Agriculture and Agri-Food Canada. To obtain values for honey output, sales are deflated by prices of output. The consumer price index (CPI) (CANSIM P700000), price index of honey containers (CANSIM II SERIES V1574833), price index of utilities, interest rates are obtained from Statistics Canada (CANSIM B14016/ Matrix 2526). The GDP deflator (V647710) and Fixed Capital GDP deflator (V647718) are obtained from CANSIM II to compute per unit cost of capital. A summary of data sources is given in Table 2-2. Table Descriptive statistics are given in Table 2-3 and Table 2-4.

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[12] CANSIM stands for the Canadian Socio-Economic Information Management System.

2.6 Model Results and Discussion

Parameters for the systems of cost and share equations are estimated using the nonlinear least squares procedure in Time Series Processor (TSP) 4.5. Five separate short-run cost and cost share system of equations – two for processing marketing co-operatives [restricted (LF) and unrestricted (AHP)] one for a federated wholesaling co-operative (FCL), one for a retail farm supply co-operative UFA), and one for a grain marketing co-operative (SWP) – are estimated. The nonlinear least squares parameter estimates are given in Table 2-7 to Table 2-11. Reasonable numbers of estimated cost function parameters are statistically significant at the 5 per cent level. The R^2's for the estimated equations are within the reasonable range (Table 2-6). Tests for autocorrelation are conducted for each model using a Likelihood Ratio test. The calculated chi-square values are given in Table 2-6. The critical chi-square value is 3.841 for one degree of freedom at a 5 per cent significance level suggesting that there is an autocorrelation problem for the AHP and LF models. The existence of residual autocorrelation for the LF and AHP models may be an indication of incorrect functional form, omitted variables, or missing dynamic specification (Verbeek, 2000). Those models are corrected for first-order autocorrelation.

For the co-operative firms' optimization behaviour to be consistent with cost minimization, the estimated cost functions must fulfill the regularity properties of a dual cost function. In this study, the homogeneity and symmetry restrictions are imposed prior to estimation. The curvature and monotonicity conditions are checked. Monotonicity requires that the estimated cost shares equations and the estimated elasticity of cost with respect to output be nonnegative. Monotonicity in input prices and output is evaluated at the mean value and it is found to hold for all models.

Concavity requires that the Hessian matrix be negative semi-definite. The cost function is concave if the eigenvalues of the Hessian matrix are negative or zero at each data point. The eigenvalues are calculated at the mean value of variables in the model. The calculated eigenvalues are non-positive for all estimated cost functions. Thus, the current cost functions fulfill the regularity property of concavity. In general, the estimated cost functions are consistent with the cost minimization behaviour, given other un-modeled effects.

2.6.1 Elasticities of Substitution

Often Allen elasticities of substitution (AES) are used to demonstrate estimated substitution possibilities between inputs. The Allen partial elasticities of substitution (σ) can be calculated as $\sigma_{ii} = \left(\beta_{ii} + S_{it}^2 - S_{it}\right)/S_{it}^2$, i= i-th input; and $\sigma_{ij} = \left(\beta_{ij} + S_{it}S_{jt}\right)/S_{it}S_{jt}$, i,j= i-th, j-th input (i≠j). The AES is calculated at the mean value of input shares and other variables and are given in Table 2-12 and Table 2-13. The cross AES among inputs are all positive for both regulated and unregulated cost functions suggesting that inputs used in the processing activities of the co-operatives are substitutes. For the FCL, SWP and UFA model the cross substitution elasticity between labour and other inputs is positive and statistically significant. The signs of the own AES for all models are negative which conforms to economic theory.

2.6.2 Input Price Elasticities of Demand

The cost structures of the co-operative agribusiness firms can further be explored by computing compensated input demand elasticities. The own price elasticities of demand are calculated as $\varepsilon_{ii} = (\beta_{ii}/S_{it}) + S_{it} - 1$. The cross price elasticity of demand of the ith input with respect to the jth input price is calculated as $\varepsilon_{ij} = (\beta_{ij}/S_{jt}) + S_{jt}$.

The estimated short-run own price elasticities of input demand for restricted and unrestricted cost functions have the expected sign confirming to the economic theory. Consistent with the Le Chatelier-Samuelson principle or Envelope theorem (Varian), the short-run own price elasticities are higher (in absolute value) for the co-operative firm in an unregulated industry. The estimated elasticities are given in Table 2-14 and Table 2-15. For Alberta Honey Producers Co-operative, the short-run own price elasticities of input demand are -1.0085, -0.2875, and -0.6233 for labour, raw material and other inputs, respectively, and are statistically significant at a 1 per cent significance level. For Lilydale Poultry Co-operative, the short-run own price elasticities of input demand for labour and other inputs are -0.4310 and -0.5349, respectively, and are also statistically significant at the 1 per cent significance level. As compared to the unrestricted model, labour and other inputs are less elastic for the restricted short-run cost function. For Federated Co-operative, the estimated labour and material inputs demand elasticities of price are –0.3113 and –0.5001, respectively. For Saskatchewan Wheat Pool, the estimated labour and material inputs demand price elasticities are -0.210 and -0.010, respectively. For United Farmers of Alberta, the estimated labour and material inputs demand price elasticities are -0.373 and -0.020, respectively.

Output elasticity of demand is calculated to examine the responsiveness of input demand to changes in output (Table 2-16). For Alberta Honey Producers Co-operative, the output elasticities of demand for labour, raw materials and other inputs are 0.257, 0.860, and 0.765, respectively, and are statistically significant at the 5 per cent level. For Lilydale Poultry Co-operative, the output elasticities of demand for labour and other inputs are 0.595 and 0.472, respectively, and are statistically significant at the 5 per cent level. For Federated Co-operative, the output elasticities of demand for labour and other inputs are 0.688 and 0.554, respectively, and are statistically significant at the 5 per cent level. The output elasticity of demand for Saskatchewan Wheat Pool is 0.121 and 0.161 for labour and other inputs, respectively, and are statistically significant at the 10 per cent level. For United Farmers of Alberta cost function, the output demand elasticity for labour and other inputs are 0.081 and 0.126, respectively, and are statistically significant at 10 per cent level. All of the signs for the elasticities are as expected. The above results suggest that demands for all inputs increase with increased in output, which is consistent with the monotonicity property.

2.6.3 Returns to Scale

Returns to scale is technical property of the production function that measures "economies of scale" (i.e. advantages to size) or "diseconomies of scale" (i.e. disadvantages to size). Table 2-17 shows returns to scale measures for the case firms. Model results indicate that increasing returns exist for each of the case firms with the magnitude being greatest for Saskatchewan Wheat Pool and United Farmers of Alberta. Returns to scale suggest that case co-operatives have not reached their optimal size. These results may indicate that the case firms are operating under suboptimal firm size, suggesting why some co-operatives are involved in merger and acquisition, increasing plant capacity using increased debt borrowing or by going public. For example, based on an out of sample forecast a 10 per cent increase in output for AHP would have resulted in approximately a 5 per cent decrease in average variable costs of production and about a 9 per cent reduction in marginal costs of production. For UFA, all other things being constant, a 10 per cent increase in its value added would have resulted in approximately 9 per cent reduction in average variable costs of production.

2.6.4 Agency Costs of Debt

The main objective of this study is to examine if there are any agency costs of debt impacting decision making in co-operative agribusiness firms in Western Canada. First, the hypothesis that debt is not an argument of the cost functions for the agribusiness processing co-operatives is tested using Likelihood Ratio tests.

The calculated chi-square is 14.642 while the critical chi-square value is 12.590 at a 5 per cent significance level with six degrees of freedom for the AHP model. For the LF model, the calculated chi-square value is 15.070 with a critical chi-square value of 11.071 at the 5 per cent significance level with five degrees of freedom. Thus the null hypothesis that debt level does not affect the co-operative agribusiness firms' total variable costs is rejected at the 5 per cent level of significance. For FCL, the calculated chi-square value is 0.45 with 5 degrees of freedom implying that debt is not an argument of the Translog cost function. For the SWP and UFA models, the calculated chi-square values are 17.508 and 17.062, respectively. The critical chi-square value is 11.071 at the 5 per cent significance level with five degrees of freedom indicating that for both Saskatchewan Wheat Pool and United Farmers of Alberta models debt is a shifter of the short run variable cost function.

2.6.4.1 Alberta Honey Producers Co-operative

The AHP co-operative is a member owned co-operative that processes and packages pure natural honey and honey related products. The AHP co-operative has the largest retail outlet in Western Canada for beekeeping equipment, supplies and apparel. The co-op also processes and sells beeswax products from craft grade to pharmaceutical.

Over the period analyzed in this study, AHP showed a significant dependence on debt financing. As evident from Figure 2-4, AHP's debt to equity ratio was moving strongly upward in the latter part of the 1990's up to approximately 5 in the mid 1990's. For the AHP co-operative, the cost elasticity of indebtedness is calculated at the beginning (1975), middle (1985), and ending (2001) values of the time series (Table 2-19). The elasticity is also estimated at mean values of the variables in the model. For the AHP co-operative model, the estimated cost elasticity of debt is 0.067, and is statistically significant at the 5 per cent level of significance. This is consistent with the prediction of the agency costs of debt that as debt increases there is a decrease in cost efficiency. This suggests that as the level of debt increases managerial efforts to increase the firm's value decrease resulting in a decrease in the efficiency of resource use. Other things held constant, a 10 per cent increase in the level of debt has resulted in 0.67 per cent increase in the total variable costs of production for AHP co-operative due to conflict of interests. This result is also consistent with the comments from Bee Maid Honey Limited Chair of the Board quoted below.

> *With the management agreement with Bee Maid Honey Limited, we have been able to compare and evaluate the salary arrangements with staff at all levels with the organizations; some inequalities have been found and are being corrected. The employees deserve to be paid fairly for the efforts they put forth for the organization ... It is evident that we are not yet totally efficient in our management and organization... -Chairman of the Board (Alberta Honey Producers Co-operative Limited, Annual Report 2002: p.3).*

The effects of individual variables on the cost elasticity of debt can be explored using the second-order coefficients. For example, β_{Dy} measures the effect of debt on variable costs of production for different levels of output. For the AHP co-operative, the estimated value of this coefficient is -0.153, significant at the 5 per cent significance level, indicating that increases in debt resulted in lower variable costs as AHP co-operative firm's output increased. All other things being constant, a 10 per cent increase in output for AHP would have resulted in approximately 25 per cent reduction in agency costs of debt. The parameter estimate of β_D (0.034) is positive and that of β_{DD} (-0.047) is negative which suggests the direction of the neutral shift in cost function is unclear. If the effect of β_D (0.034) outweighs that of β_{DD} (-0.047), there would be an upward neutral shift in cost function, with a downward shift otherwise. Parameter estimates for β_{LD} (-0.001), β_{RD} (0.010), β_{HD} (-0.009) are statistically insignificant suggesting that there are no biased shifts in the cost function.

To explore the impact of indebtedness on input demand, the elasticity of demand for the i-th input with respect to debt is derived below. The cost share of the i-th input is defined as:

$$S_{it} = \frac{w_{it} x_{it}}{SVC_{it}} \Rightarrow x_{it} = \frac{S_{it}.SVC_{it}}{w_{it}} \Rightarrow \ln x_{it} = \ln SVC_{it} + \ln S_{it} - \ln w_{it} \qquad (2\text{-}33)$$

Taking differentiating quantity of input with respect to debt gives:

$$\frac{\partial \ln x_{it}}{\partial \ln D_{it-1}} = \frac{\partial \ln SVC_{it}}{\partial \ln D_{it-1}} + \frac{\partial S_{it}}{\partial \ln D_{it-1}} - \frac{\partial \ln w_{it}}{\partial \ln D_{it-1}}, \text{ but } \frac{\partial \ln w_{it}}{\partial \ln D_{it-1}} = 0 \qquad (2\text{-}34)$$

$$\Leftrightarrow \frac{\partial \ln x_{it}}{\partial \ln D_t} = \left(\frac{\beta_{iD}}{\beta_i + \sum_j \beta_{ij} \ln w_{jt} + \beta_{iD} \ln D_t + \beta_{iy} \ln y_t + \beta_{ik} \ln k_t + \beta_{it} \ln Time} \right) + \left[\beta_D + \beta_{DD} \ln D_t + \beta_{yD} \ln y_t + \sum_j \beta_{jD} \ln w_{jt} + \beta_{kD} \ln k_t \right] \qquad (2\text{-}35)$$

$$\Leftrightarrow \varepsilon_{itD} = \frac{\partial \ln x_{it}}{\partial \ln D_t} = (\beta_{iD}/S_{it}) + AC_t \tag{2-36}$$

where

$$AC_t = \frac{\partial \ln SVC_t}{\partial \ln D_t} = \left(\beta_D + \beta_{DD} \ln D_t + \beta_{yD} \ln y_t + \textstyle\sum_j \beta_{jD} \ln w_{jt} + \beta_{kD} \ln k_t\right)$$

The estimated input demand elasticities with respect to debt are 0.052, 0.079 and 0.033 for labour, raw materials and other input category, respectively, for the AHP co-operative (**Table 2-18**). For raw material, as an example, a 10 per cent increase in debt may lead to a 0.79 per cent increase in the demand for raw honey. Thus, debt has increased the demand for labour and raw materials which is a combination of biased and neutral effects of debt.

2.6.4.2 Lilydale Foods: Supply Management Matters

LF was established in 1940, when a group of farmers established the "Alberta Poultry Producers Ltd." to help them provide better quality poultry products to a wider consumer base. The company's first plant was purchased in the downtown sector of Edmonton, Alberta in October, 1941. This first plant, called the Wainberg plant, was the headquarters for the company from 1941 to 1967. Currently, Lilydale has HAACP approved processing plants in Abbotsford, Port Coquitlam, Lethbridge, Calgary, Wynyard and 3 plants in Edmonton, including the head office. Lilydale has 5 hatcheries, 1 egg plant and 1 equipment manufacturing division. Lilydale provides products for all of Western Canada, including British Columbia, Alberta, Saskatchewan, and Manitoba, as well as parts of the Yukon, North West Territories and Quebec. The company also exports to Japan, Mexico, Russia, and the United States. Lilydale has become a fully diverse food processing company with focus on a growing international market place. Lilydale prides itself on its extensive product line, with hundreds of products including chicken, turkey, beef and pork. Over time, LF has increased its debt-equity ratio from approximately 1.17 in 1990 to 2.23 in 2000, suggesting increasing dependence on debt financing for investment (Figure 2-5).

For Lilydale Foods the estimated cost elasticity of debt is negative and statistically significant. This suggests that the agency costs of debt decrease as leverage increases. This may, however, be interpreted as agency costs of equity; that is, the higher the proportion of equity capital the higher the costs of production. Based on the hypothesis and empirical results it is possible that supply management might have lessened agency costs of debt. This might have been due to the fact that supply management, through predetermined levels of raw materials, is equivalent to a system of monitoring the level of processor output and avoiding managerial shirking-effects that affect the level of output negatively. According to the Lilydale Foods 2001-2002 annual report,

> *Within the industry, supply of product to processing plants is governed by national and provincial boards that directly impact quantities and live prices. As a result, the Co-operative only has control over the efficiency of its operations, which is a much smaller component of the total cost of merchandise [i.e., total variable costs] sold (p.28).*

In the estimation of the systems of cost and shares equations, dummy variables are included for Lilydale model in order to capture major structural changes that have occurred over time. These periods are provided in Table 2-5. Results suggest that the cost share of labour has gone down since the purchase of the de-boning plant in Edmonton. The coefficients for dummy variables representing the structural changes in the 1980's (i.e., in 1983 and 1986/87) are statistically significant and positive. This suggests that total cost and cost share of labour increased after these changes. Finally, the coefficients for the purchase of a plant in Saskatchewan in 1999 are statistically significant and negative for labour cost share equation. This may indicate that cost share of labour decreased after this period.

2.6.4.3 Federated Co-operative Limited: Corporate Governance Matters

FCL, a federally regulated co-operative, is the second largest Canadian co-operative in terms of revenue. FCL is owned by more than 300 retail co-operatives as their own central wholesaling, manufacturing and administrative organization. The retail co-operatives serve an estimated 1,000,000 individual co-operative members from Thunder Bay in northwest Ontario to the Queen Charlotte Islands on British Columbia's West Coast, and from the U.S. border to the Arctic Circle. The Co-operative Retailing System employs more than 3,000 people within FCL and an estimated 15,000 people at retail co-operatives, for a total workforce of more than 18,000 people in western Canada. Over the study period, the long term debt to equity ratio for FCL was consistently decreasing, suggesting limited dependence on debt for financing capital investment. Yet, short term debt was increasing after the mid 1990's (Figure 2-6).

For FCL, the demand elasticity with respect to debt is -0.0213 and -0.0268 for labour and other inputs, respectively, but statistically insignificant at the 10 per cent level. The absence of agency costs of debt for Federated Co-operatives may be at least partially explained in terms of its co-operative governance. In the quest for successful business operation, good governance – the way a company is directed and controlled- is indispensable. A co-operative with sound corporate governance demonstrates that the board of directors and management are accountable to the members for the performance of the business and the stewardship of assets. Such a co-operative may be viewed as innovative, transparent and more attractive to existing and potential members. This condition may lead to easier access to investment capital. In addition, as noted earlier, there are incentives, within a federated governance structure, for individual member co-operatives to take an active role in ensuring efficient decision-making. Collaboration among local co-operatives on strategic research is also beneficial as risk reduction and cost sharing are achieved (Kyriakopoulos, 1998).

The results in this study do not imply that the federated co-operative is always an efficient structure (Kyriakopoulos, 1998). Co-operatives organized in the federated system may suffer from certain drawbacks when their entrepreneurial decisions are taken into account. Competition among local member co-operatives may be counterproductive, impairing coordination of processing or marketing functions (Schrader 1989) at the federated level.

As stated in its annual reports, one of the principal activities for the FCL involves provision of organizational and management services to the member retail co-operatives. The Canadian Co-operative Association (CCA) cites Federated Co-operative Limited as an example of good co-operative governance. According to the Canadian Co-operative Association:

> *...Federated Co-operatives Ltd. conscientiously breathes life into the co-operative principles in its governance.... Member co-ops are supported by courses in human resources, financial services, member relations, etc. (Canadian Co-operative Association. Autumn 2002. Those Things We Stand For: http://www.coopscanada.coop/NewsLetter/Governance/.)*

Furthermore, a closer look at the trend in the long-term debt of FCL shows a consistent decline over time going down to zero in 1998 and later years (Figure 2-6). This may indicate a behavioural change on the part of the decision makers in order to reduce the costs of borrowing (both direct and indirect). The coefficient β_{Yd} is equal to -0.032, suggesting that variable cost declines with debt as output increases. Yet, this coefficient is statistically insignificant. The parameter estimates of β_D and β_{DD} are statistically insignificant suggesting that there is no neutral shift in cost function. The parameters estimates for β_{LD} (0.001) and β_{HD} (-0.001) are statistically significant. This may imply that labour cost share increases and other input cost share decreases as debt increases.

2.6.4.4 United Farmers of Alberta

The UFA was founded in 1909 as a merger of the Society of Equity in Edmonton (1905) and the Alberta Farmers Association (1906). UFA was an amalgam of a local club and a political lobby group. Today, UFA is one of Canada's largest agricultural organizations with over 106,000 active members. With its 34 farm supply stores throughout Alberta and over 120 petroleum and fuel cardlock outlets located throughout the province, as well as in British Columbia and Saskatchewan, UFA offers a wide range of products and services for farms, ranches, homes and businesses. It was also involved in marketing farmers' grain. According 2003 UFA's Annual Report:

> *UFA's business is distributing petroleum and farm supplies to farmers, ranchers, consumers and commercial accounts. UFA provides crop protection products, farm buildings, housing packages, lumber, grain storage units, livestock supplements, feed grain trading services and related goods and services to rural communities. UFA's staff and independent agents utilize 118 petroleum outlets, 34 farm supply stores and Stirdon/Betker facilities to service its members and customers.* (p.1).

Over the study period, the debt to equity ratio for UFA's is lower as compared to other co-operatives (Figure 2-7).

The cost elasticity of indebtedness, calculated at the mean value of the time series, is equal to 0.030 and is statistically significant at the 5 per cent level. All other things being equal, on average, a 10 per cent decrease in the level of debt would have resulted in 0.3 per cent decrease in variable costs of production for UFA. The extent of agency costs of debt for UFA is lower than that for the two marketing co-operatives (i.e., AHP and SWP). This is consistent with predictions based on theory. The coefficient β_{Yd} is equal to -0.002 and is statistically significant at the 5 per cent level. This result may suggest that debt has a negative impact on variable costs of production as output increases. The parameter estimates for β_D (0.023) and β_{DD} (0.002) are statistically significant suggesting that debt has resulted in an upward shift in the cost function. For UFA, debt has also resulted in a biased shift in the cost function; that is, $\beta_{LD} = 0.0003$ and $\beta_{HD} = -0.0003$.

The effects of debt on variable costs of production increases as the level of capacity increase (i.e., $\beta_{DK} = 0.008$).

2.6.4.5 Saskatchewan Wheat Pool: Going Public

SWP is a publicly traded agribusiness and is the largest grain handler and marketer in Saskatchewan. SWP is a company that started out as a co-operative of Saskatchewan farmers trying to get a "fair price" for their crops and turned into one of the province's biggest companies. On Aug. 25, 1923, the Saskatchewan Co-operative Wheat Producers Ltd. was established and shares were allotted to those who would eventually form the company's first board. It has been informally called the Saskatchewan Wheat Pool ever since. During the period 1990-2002, the Saskatchewan Wheat Pool had debt-equity ratios above 1.0, with the exception of 1992 and 1999, suggesting a need to reduce its debt load (Figure 2-8). The debt burden is largely because of the elevator construction race across the prairies.

> *The Saskatchewan Wheat Pool (SWP) was sliding toward an inexorable debt crisis. Only through a fire sale of assets was it able to meet debt-repayment obligations in fall of 2002* (Byfield, 2002).

The SWP currently faces considerable financial and organizational challenges (Fulton and Giannakas, 2001).

For SWP, the variable cost elasticity of indebtedness at the mean value of the series is 0.055 and is statistically significant at the 5 per cent level. On average, variable costs of production would have decreased by 0.55 per cent had debt been reduced by 10 per cent, all other things being equal. The following observation may support the agency costs of debt resulting from over-investment in negative NPV project:

> *Before going public in March of 1996, the company had gone deeply into debt to acquire several subsidiaries. Farmer-members, who know all too well how dangerous that can be, were unnerved by the Pool's activities. They had joined the pool to avoid debt and to unify against corporate interests who, they felt, were out to swindle them out of a season of hard work. ... At the same time Wheat Pool members were getting older, and one of the benefits of being a member is that at retirement you can cash out your investment. In 1995 the Pool expected 46 per cent of its members to do just that within 10 years. Going public seemed the best way to generate revenue for a looming cash crunch. ... The Pool was also slimming down its grain handing operations in 1995. Only 564 grain elevators were operating when the company went public and it was planning to close more at a rate of 20 a year in conjunction with planned rail closures. Class B shares opened on the Toronto Stock Exchange in 1996 at $12 each; they traded as high as $24 in late 1997. Now, as the Pool tries to pull itself from the jaws of bankruptcy, its shares are hovering around 70 cents each. http://sask.cbc.ca/saskpool/4.html (Accessed: October 21, 2004).*

Macey (1997) argues that if the corporate governance system in a particular jurisdiction is not functioning well, entrepreneurs will not be able to make credible commitments to outside investors that they will be treated fairly after their initial investments have been made. The fact that SWP's share price is not performing well may partly indicate the existence of 'ineffective' corporate governance resulting in significant agency costs of debt.

> *Investors will not pay full value for firms with weak corporate governance because they will discount the price they pay for such firms by an amount sufficient to compensate them in the future for possible exploitation by management.* (Macey, 1997).

Further to this analysis, in the case of SWP public offering there are agency problems between members of the co-operative and external investors. The co-operative members' objective is to receive higher prices for their farm products whereas external investors' objective is lower prices for products purchased from member (non-member) farmers. As a result the public/external investors may have less confidence on the expected future benefits they may receive from the co-operative and hence they pay low price for the firm.

Investment in negative NPV projects may also be the case for SWP. For example, although SWP diversified into pork production, feed processing, and aquaculture industries, the discontinuation of these operations (in 2004) may indicate investment in negative NPV projects. The acquisition of Humboldt Flour Mills Inc., in May 1998 provides another instance of investment in a negative NPV project. In general, when faced with surplus cash, management can engage in additional investment of self-serving projects rather than distributing the cash to members. Such decisions can include: (i) empire building (e.g., Shleifer and Vishny, 1997); (ii) perquisite consumption (e.g., Jensen and Meckling, 1976), (iii) diversifying acquisitions (e.g., Morck, Shleifer and Vishny, 1990); and (iv) subsidizing poorly performing divisions using the cash generated from successful ones instead of returning the cash to the shareholders (e.g., Jensen and Meckling, 1976). The examination of individual parameter estimates indicates that debt has resulted in a neutral shift in the cost function (β_{DD} = -0.097 and statistically significant).

2.6.5 Capital Constraint Hypothesis

In this section of the study the second objective is to determine the effect of debt on investment in fixed capacity of co-operative agribusinesses. Following Conard and Unger (1987) and Featherstone and Al-Kheraiji (1995) the effect of debt on co-operative agribusiness firm's long-run optimal capacity can be determined by testing whether the firm is operating at long-run optimum capacity. Suppose the total or long-run cost, TC, is defined as the sum of variable and fixed costs, $LTC = SVC + P_k K$, where P_k is the price of capital[13]. Based on the approach proposed by Conard and Unger (1987) the following long-run capacity share equation (SF) is specified to test if the co-operatives operate at optimal capacity:

$$S_{Ft} = \frac{\partial \ln VC}{\partial \ln K^*} = \frac{-p_k K^*}{VC} = \alpha_k + \alpha_{kk} k_t + \alpha_{yk} \ln Y_t + \sum_j \alpha_{jK} \ln w_{jt} + \alpha_{kD} D_t \quad (2\text{-}37)$$

The test for validity of a long-run equilibrium is based on testable properties of the short-run equilibrium. The null hypothesis is that the observed capital stock is at its long-run desired level, K^*. If the long-run capacity is in equilibrium, the parameters of the capacity share equation are equivalent to the parameters of the short-run cost function

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[13] The following formula is used to calculate the service cost of capital: $p_k = q(i + \delta - \pi)$ where δ is the capital depreciation rate, q is the acquisition price of capital, π is the rate of inflation in the economy, and i is the interest rate.

(Featherstone and Al-Kheraiji, 1995; Conard and Unger, 1987). Therefore, a joint test of the null hypothesis that the parameters of equation (2-28) and (2-37) are equal can be conducted. To test for null hypothesis the following restrictions are jointly tested: $\beta_k = \alpha_k, \beta_{kk} = \alpha_{kk}, \beta_{yk} = \alpha_{yk}, \beta_{jk} = \alpha_{jk}, \beta_{kD} = \alpha_{kD}$. Test statistics based on the likelihood ratio are employed to test the restrictions across the equations.

Table 2-20 depicts the results of the short-run and long-run optimization of capacity tests. For all case firms, the set of restrictions on the parameters of the Translog system of equations implied by long-run equilibrium are rejected at the 5 per cent level, suggesting that the levels of capital stock might have restricted the co-operative firms' optimal allocation of resources. These results are consistent with previous studies of supply and marketing co-operatives (Featherstone and Al-Kheraiji, 1995).

Once it is found that the case co-operative firms are not in their long-run equilibrium, the next step is to determine whether the co-operatives are overcapitalized or undercapitalized by comparing the predicted long-run optimal capacity with actual capacity. To do so, the estimates from the Translog cost functions (equation 2-28) are substituted in the capacity share equation (2-37) and the estimated capacity shares are then compared with the actual capacity shares. More than 90 percent of the time all case co-operatives were capacity constrained. This is consistent with the hypothesis that co-operatives are characterized by capital constraints (Chaddad, 2001). Further regression analysis is conducted to explore if indebtedness has an impact on the divergence between the optimal and actual capacity. The difference between the optimal and actual capacity is regressed on logarithm of debt and logarithm of value added. The results are given in Table 2-21.

For the LF, FCL and AHP co-operatives, the results in Table 2-21 indicate that debt has a negative impact on the divergence from optimal long-run capacity. For these co-operatives, the higher the level of debt, the lower the divergence between the optimal and actual capacities. For SWP and UFA, the level of debt did not affect the divergence in optimal capacity. This may be an indication that capacity expansion by some of these case co-operatives may have been financed mainly by debt.

2.6.6 Tax Benefits and Default Costs (Agency Costs) of Debt

One implication from the Modigliani and Miller (1958) theorems is that the value of a company is not affected by the way the company finances its operations; the value of a company equals the present value of its operational cash flows, regardless of whether the firm finances its projects by issuing stocks, bonds, or some other security. To derive the irrelevance theorems, Modigliani and Miller (1958) had to make very strong "perfect capital markets" assumptions: lenders and borrowers have the same borrowing rate, there are no corporate or personal taxes, and all players in the economy have access to the same information, among others. In this section, the focus is on tax savings. Because the interest on debt is tax deductible, by financing with debt a firm reduces its tax liability. Therefore, stockholders/members are able to pocket the tax savings that are achieved by financing with debt. The question to ask is, however, "*how much do these tax savings add to firm value?*"

Using the estimated cost functions and marginal tax benefits, the trade-off between tax savings and default/bankruptcy costs resulting from agency problems can be explored. The literature assumes that there is an exogenous cost of default- a bankruptcy cost – related to debt. This bankruptcy cost is a disadvantage of issuing too much debt that is traded off against the taxes saved. This forms the basis for the traditional "trade-off" approach to capital structure in Robichek and Myers (1965) and Kraus and Litzenberger (1973). This approach does not analyze the source of such bankruptcy costs or allow any non-tax benefits of debt. It predicts that firms with high-variance cash flow distributions will choose less debt and more equity than those with low variance. It also predicts that firms will be financed only with equity when there is no corporate income tax advantage to debt. Since taxes and bankruptcy costs do exist, it is important to examine the trade-off between the two.

The effect of a unit increase in debt on total variable costs can be given by the derivative $\partial SVC/\partial D$. The estimated value of this derivative for AHP is 0.066 at the mean value of the variable in the model, suggesting that a permanent $1 increase in AHP firm's debt level may, on average, increase total variable costs by about 6.6 cents, attributable to agency problems. For LF, the value of the derivative $\partial SVC/\partial D$ is 0.005 and is statistically insignificant suggesting the likely absence of any direct effect of debt on variable costs. The fact that the default/agency costs of debt is smaller for LF, as compared to AHP, and statistically insignificant is consistent with the theoretical prediction that supply management regulation serves as a control mechanism.

Assuming an average corporate tax rate of 45 per cent for manufacturing and processing firms paying 12 per cent (bank prime rate) interest, co-operative firms may save approximately 5 cents per dollar debt annually on corporate income tax[14]. Other things being equal, if this assumption is tenable and co-operatives are paying corporate tax, it can be argued that AHP marginal agency costs (6.7 cents per dollar debt) are higher than the likely marginal tax benefits of borrowing. For UFA and SWP, the marginal agency costs are about 5.7 cents and 5.5 cents per dollar debt, respectively. It should be mentioned, however, that there might be other benefits (i.e., debt adds discipline to management) and costs (i.e., bankruptcy costs, loss of future flexibility) related to borrowing. According to Miller's equilibrium[15], the firm under the above corporate tax rate and yield might not issue debt for yields higher than 27 per cent assuming riskless perpetual debt. Taking into account data measurement errors, specification error, econometric problems and other un-modeling effects it can be argued that the estimated agency cost figures for AHP, UFA and SWP are within a reasonable range. In summary, in the presence of debt-related agency costs and tax subsidies, there is an interior optimal capital structure when the present value of the expected tax savings is offset at the margin by the present value of the expected agency costs.

2.6.7 Dynamic Simulation

Holding other things constant, an increase in debt reduces the manager's work effort under asymmetric information (Brander and Spencer, 1989) resulting in increased variable costs of production emanating from agency costs of debt. To investigate the dynamic impacts of debt on variable costs and input demand a deterministic dynamic simulation is run for the honey model with and without debt (by setting the coefficients of debt to zero). For HPC, UFA and SWP, the results from this analysis are given in Figure 2-9 to Figure 2-14. Results suggest that the impact of debt is not regular over time. For example, for AHP over the period 1985-1995 debt leveraging resulted in increased cost efficiency. But for the periods before and after 1985-1995, debt resulted in cost inefficiency in most of the series. Consistent with simulation results for total variable costs, the expenditures on all the three inputs used by the AHP has shown a downward shift during the period 1985-95 for most of the series for the model with debt.

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[14] The marginal tax subsidy associated with issuing riskless, one-period debt, is equal to $\frac{\tau_c . r}{(1+r)}$, where τ_c is corporate income tax rate and r is bond yield rate.

[15] According to the Miller Equilibrium, business firms will not issue debt at a yield higher than $\frac{r}{(1-\tau_c)}$. At this level the supply curve of riskless perpetual debt is infinitely elastic (Barnea et al., 1985).

2.7 Concluding Remarks

This paper provides empirical evidence on the principal-agent problems associated with debt leveraging for five co-operative firms in Western Canada. Although specific to the co-operatives investigated, the results here may also reflect conditions in other co-operatives with similar characteristics. The results reveal that there are significant agency costs for three of the co-operatives.

The indirect costs associated with asymmetric information or differing market incentives are empirically measured using separate dual cost functions for the AHP (unregulated industry), LF (regulated industry), for the FCL (federated co-operative), for UFA (non-federated co-operative) and SWP (publicly traded co-operative). Although previous empirical evidence has invariably reported the existence of agency costs of debt for aggregate samples or industries, the agency cost of debt in this study is found to be firm-specific. Model results revealed the presence of significant agency costs of debt for AHP, UFA and SWP resulting from lower probability of exerting higher effort level or higher probability of exerting lower effort levels as debt increases. For LF (i.e, the regulated firm), although there is a neutral shift in the variable cost function, there are no significant agency costs of debt. This could be due to effectiveness of monitoring with economies of scale; that is, cost inefficiency decreases with increase in debt as output and capacity increase for LF.

These findings are consistent with the theoretical prediction that agency costs of debt may be higher in unregulated industries and are modest or absent under regulated environments. In general, the firms' financial structure has affected the total variable costs of production and hence the cost efficiency. For FCL as well there are no significant agency costs of debt which may give an indication as to the importance of effective governance structure that ensures that a co-operative's directors and managers act in the interests of the co-operative and its members.

Results in this study are consistent with previous studies of supply and marketing co-operatives. Featherstone and Al-Kheraiji, (1995) found that a 10 per cent increase in debt leads to a 1.67 per cent increase in variable costs of production. In a similar study for the airlines industry Kim and Maksimovic (1990) investigated the existence of agency costs of debt and found that a 10 per cent increase in debt results in a 0.34 per cent increase in short run variable costs of production. For the U.S. manufacturing industry, Bernstein and Nadiri (1993) examined the existence of agency costs of debt and found that increase agency costs of debt reduced the total factor productivity by 3.3 per cent. In another study, agency costs of debt reduced the productivity growth of the U.S. food manufacturing industry by 12.25 per cent. Using the input demand elasticity of debt, debt is found to influence the level of input utilization for AHP, UFA and SWP.

Measures of returns to scale reveal that all case co-operatives examined exhibit significant economies of scale. Because larger size can provide lower per unit costs, increase in size or merger/consolidation could result in cost savings. The policy implication of these results is that the case firms have to either increase in their size or merger/consolidate with other co-operatives as a strategic move towards a gain from scale economies. The results from the test for long-run equilibrium as well suggest that case co-operative firms are capacity/capital constrained. Further analyses have shown that debt leverage influences firm capacity for AHP, UFA and LF.

In general, the following preliminary conclusions may be drawn from this study: (i) Agency costs of debt may have a consequential influence on the cost efficiency of co-operative agribusinesses; the impacts of agency costs of debt on cost efficiency may be significant under an unregulated industry environment. Thus, agency costs of debt have differential effects under different regulatory environments. (ii) Agency costs of debt may have an impact on processors' input demand under an unregulated industry environment. (iii) Debt financing may provide a tax shield, but excessive debt may increase potential agency costs. Co-operative firms may take into account the trade-off between marginal tax subsidy and marginal agency costs of debt; and hence there is an optimal capital structure. Thus, capital structure may matter in a firm's decision making. (iv) The type of co-operative governance structure (i.e., federated or centralized) may have an impact on the level and existence of agency costs of debt via its likely effect on co-operative governance. (v) Debt leverage may have an influence on the divergence between optimal and actual plant capacities.

In conclusion, agency costs of debt may have a consequential influence on the cost efficiency of co-operatives. Thus, if there are any agency costs, capital investment decisions or capital budgeting analysis should account for the agency costs of debt. Rational bondholders recognize the increased probability of default on their claims and discount it in the price they are willing to offer the firm for its bonds (Barnea et al., 1985). Consequently, the members of the co-operative are apparently forced to suffer the full burden of the agency costs of debt. If the agency costs of debt exist but not included, it may lead to an overestimation of the net benefits of capital investment. Finally, since this is a comparative case study, the findings cannot be generalized to other co-operatives. In addition, in some cases, note that it is impossible to distinguish whether long term debt is a sufficient proxy for agency problem or a proxy for other unfavourable states of the world.

In retrospect, there are a few, specific limitations in this research which should be addressed as a means for improvement or potential strategies for further study. One of these limitations focuses on the quality/accuracy of data acquired for the analysis (i.e., output, labour, other input measures). For example, since the co-operatives studied are involved in diversified products, multi-product costs function may be appropriate. This may be overcome by obtaining disaggregated data.

Table 2-1: Data Descriptions for Four Studies Measuring Agency Costs of Debt Using Production Theory

Data Sources	Output(s)	Variable input(s)	Fixed input	Debt
	Featherstone and Al-Kheraiji (1995)- U.S. Supply and Marketing Co-operatives			
The Co-operative Finance Association	Grain, Feed, Fertilizer, Chemical, Petroleum, others. Annual sales were converted to output levels by dividing by 12-month moving averages of the producer price indexes. The shares of soybeans, corn, sorghum, winter wheat and spring wheat production for the state in which the co-operative was located were multiplied by their respective price indexes to construct a grain index. Sales of fertilizer, chemical, petroleum and feed were dividend by their respective price indexes. The other sale category was converted to volume dividing by the implicit GNP deflator.	Labour and other inputs. Management wages is included in the labour input. Input price of labour was the state average hourly earnings of manufacturing production workers. Price of other inputs was assumed to follow the GNP deflator.	Fixed input was measured as the book value of buildings and equipment and an approximation of the present value of lease using an infinite time horizon. The price of fixed input was the six-month commercial paper rate.	
	Kim and Maksimovic (1990)- U.S. Airlines			
	Output is a multilateral index aggregating four categories of outputs: revenue passenger-miles of scheduled and charter services, and revenue ton-miles of mail and other freight.	Labour, fuel, materials. Labour price is formed as an index of fifteen categories of employees using the multilateral index. Fuel price is dollar per gallon. Material is a residual category and its price is computed by a Tornqvist index of seven categories aggregated via the multilateral index.	The fixed input is measured as the sum of the annual service flows from flight equipment and ground property and equipment.	Level of long-term debt and the net present value of lease commitments.
	Hossain and Jain (2001) – U.S. Food Manufacturing Industry			
NEBR Manufacturing Productivity Database	Output is measured by the real value of shipments.	Labour and material. Quantity of labour is defined in millions of hours and includes only the production workers. Real wage rate is obtained by deflating the nominal wage rate with the GDP deflator.	Quasi-fixed input: capital. Real value of capital includes both equipment capital, and structure and building.	Debt is defined as the sum of installments due in more than one year on long-term loans from bank, and other long-term debt.
	Bernstein and Nadiri (1993)- U.S. Manufacturing Industry			
Bureau of Labour	Data on the quantity of output are obtained as a Tornqvisy index. The output price index is derived	Labour and intermediate inputs. Labour input is measured in	Capital is defined to be the sum of net capital	Debt is defined as the sum of installments

Statistics	implicitly as a ratio of the current value to the quantity of output.	terms of payroll hours for production workers. The labour input is the sum of hours of all persons engaged in production in manufacturing sector. The price index of labour is obtained implicitly from the series on hours and the cost of labour. The price of intermediate inputs is derived from a Tornqvist index of the prices of materials, energy and purchased services.	stocks of structures and equipment.	due in more than one year on long-term loans from banks and on other long-term debt.

Table 2-2: Summary of Sources of Data

Data	Sources			
	Annual Reports (1973-2001)	Statistics Canada	Annual Survey of Manufacturers	Others
Sales	AHP, LF, FCL, SWP, UFA			
Costs of labour	AHP, LF, FCL, SWP, UFA			SWP, UFA
Costs of raw materials	AHP, LF, FCL, SWP, UFA			
Costs of other inputs	AHP			
Long term debt	AHP, LF, FCL, SWP, UFA			
Capital investment	AHP, LF, FCL, SWP, UFA			
Wage rate			AHP, LF, FCL	SWP, UFA
Price of raw material		FCL, SWP, UFA	AHP, LF	
GDP deflator		AHP, LF, FCL, SWP, UFA		
Fixed Capital GDP deflator		AHP, LF, FCL, SWP, UFA		
Consumer price index		AHP, LF, FCL, SWP, UFA		
Utilities Price index		AHP, LF, FCL, SWP, UFA		
Transportation price index		AHP, LF, FCL, SWP, UFA		

Note: AHP = Alberta Honey Producers Co-operative; LF = Lilydale Foods; FCL = Federated Co-operative Limited; SWP = Saskatchewan Wheat Pool; and UFA = United Farmers of Alberta.

Table 2-3: Descriptive Statistics for Federated Co-operative Limited, Alberta Honey Producer Co-operative and Lilydale Foods (Real values: 1986 Base)

	Federated Co-operative Limited		Alberta Honey Producer Co-operative		Lilydale Foods	
Variables	Mean		Mean		Mean	
Wage rate (Can$/hour)	9.130	(0.440)	14.185	(3.714)	9.707	(0.460)
Raw Material Price (Can $/Lb)	--	--	0.304	(0.085)	--	--
Other inputs price (Index)	81.289	(31.758)	76.133	(5.747)	74.6	(9.3)
Raw Material Quantity (COGS/Prices)	--	--	--	--	244178000	(174315000)
Total Variable Cost (Million Can $)	121	(17.914)	8.282	(1.751)	52.523	(25.599)
Value added (Million Can$)	215	(54.37)	0.716	(0.469)	175.498	(109.334)
Output (Lb)			14.548	(3.535)		
Long-term Debt (Million Can$)	59.750	(51.740)	0.740	(0.673)	12.888	(8.091)
Capital Stock (Million Can$)	34.106	(10.241)	2.429	(1.025)	30.577	(10.744)
Labour cost share	0.558	(0.042)	0.084	(0.017)	--	--
Raw Material cost share	--	--	0.619	(0.061)	0.540	(0.069)
Other variable cost share	0.442	(0.042)	0.297	(0.054)	0.460	(0.069)

Note: Figures in parenthesis are standard deviations.

Table 2-4: Descriptive Statistics for United Farmers of Alberta and Saskatchewan Wheat Pool (Real values: 1986 Base)

	United Farmers of Alberta		Saskatchewan Wheat Pool	
Wage rate (Can$/hour)	9.090	(0.443)	16.249	(1.933)
Other inputs price (Index)	70.509	(36.840)	91.1	(16.6)
Total Variable Cost (Million Can $)	296	(207)	2218.710	(484.747)
Valued added (Million Can $)	16.500	(15.973)	185.365	(62.263)
Long-term Debt (Million Can $)	3.419	(4.389)	84.360	(102.275)
Labour cost share	0.051	(0.006)	0.046	(0.014)
Other variable cost share	0.949	(0.006)	0.954	(0.014)

Note: Figures in parenthesis are standard deviations.

Table 2-5: Major Structural Changes Occurred over the Period 1974 to 2001 for Lilydale Foods

Period	Activity	Dummy
January 1983	LF Purchased Maple Leaf 50 per cent Pincrest Food	Dum83+
November 1984	Lilydale Merger with Pan Ready Poultry	
1986	Merger with Scott Co-operative Association, B.C.	Dum86+
June 1987	Van Sausage was bought for further processing	
1995	Lilydale bought de-boning plant in Edmonton	Dum94+
	Bought Sunrise Limited	
1999	Bought Sun Poultry Co-operative (the only processor in Saskatchewan)	Dum98+

Table 2-6: Model Fit and Autocorrelation Tests for Lilydale Foods, Saskatchewan Wheat Pool, United Farmers of Alberta, Federated Co-operative Limited and Alberta Honey Producers Co-operative Translog Cost and Share Functions

	Translog Cost Function (R^2)	Labour cost Share (R^2)	Material Cost Share (R^2)	Autocorrelation (LR) Test
Lilydale Foods	0.997	0.956	---	15.458
Saskatchewan Wheat Pool	0.873	0.800	---	0.500
United Farmers of Alberta	0.973	0.703	---	2.500
Federated Co-operative Limited	0.915	0.948	---	0.100
Alberta Honey Producers Co-operative	0.930	0.662	0.636	7.582

Table 2-7: Nonlinear Parameter Estimates of the System of Equations for the Translog Cost and Share Functions for Alberta Honey Producers Co-operative (N=28)

Variables	Parameters	Estimates		Variables	Parameters	Estimates	
Constant	β_0	0.132*	(0.078)	Output x output	β_{YY}	-0.453	(0.355)
Labour	β_L	0.073***	(0.006)	Labour x Debt	β_{LD}	-0.001	(0.002)
Raw Materials	β_R	0.643***	(0.026)	Raw x Debt	β_{RD}	0.010	(0.009)
Others	β_H	0.284***	(0.025)	Other x Debt	β_{HD}	-0.009	(0.009)
Output	β_Y	0.715***	(0.079)	Output x Debt	β_{YD}	-0.153***	(0.054)
Debt	β_D	0.034	(0.029)	Debt x Debt	β_{DD}	-0.047*	(0.028)
Time	β_T	-0.023	(0.141)	Labour x Time	β_{LT}	0.011**	(0.005)
Capital	β_K	0.112*	(0.070)	Raw x Time	β_{RT}	-0.022	(0.022)
Labour x Labour	β_{LL}	-0.013**	(0.006)	Other x Time	β_{HT}	0.011	(0.021)
Labour x Raw	β_{LR}	-0.025***	(0.010)	Time x Time	β_{TT}	-0.004	(0.125)
Labour x Other	β_{LH}	0.039***	(0.011)	Labour x Capital	β_{LK}	-0.003	(0.006)
Raw x Raw	β_{RR}	0.031	(0.048)	Raw x Capital	β_{RK}	0.092***	(0.028)
Raw x Other	β_{RH}	-0.006	(0.066)	Other x Capital	β_{HK}	-0.088***	(0.030)
Other x Other	β_{HH}	-0.033	(0.074)	Output x Capital	β_{YK}	0.533**	(0.233)
Labour x Output	β_{LY}	-0.045***	(0.010)	Debt x Capital	β_{DK}	0.047	(0.040)
Raw x Output	β_{RY}	0.050	(0.044)	Capital x Capital	β_{KK}	-0.544***	(0.221)
Other x Output	β_{HY}	-0.004	(0.038)	AR(1)	ρ	0.286***	(0.068)
Log-likelihood function		194.270		Schwarz B.I.C.		-137.142	

Note: ***, ** and * refer to 1 per cent, 5 per cent and 10 per cent level of significance, respectively. Figures in parentheses are standard deviations.

Table 2-8: Nonlinear Parameter Estimates of the System of Equations for the Translog Cost and Share Functions for Lilydale Foods Co-operative (N=28)

Variables	Parameters	Estimates		Variables	Parameters	Estimates	
Constant	β_0	16.329***	(0.377)	Output^2	β_{YY}	-0.809	(0.670)
Labour	β_L	0.592***	(0.048)	Output x Debt	β_{YD}	0.076	(0.226)
Other	β_H	0.408***	(0.048)	Output x Capital	β_{YK}	-0.096	(0.225)
Raw Material	β_M	-2.277***	(0.810)	Labour x Debt	β_{LD}	0.014	(0.012)
Output	β_Y	1.530**	(0.682)	Other x Debt	β_{YD}	-0.014	(0.012)
Debt	β_D	-0.196	(0.248)	Debt^2	β_{DD}	-0.154	(0.154)
Capital	β_K	-0.0004	(0.230)	Debt x Capital	β_{DK}	0.038	(0.113)
Labour^2	β_{LL}	0.058	(0.042)	Labour x Capital	β_{LK}	0.008	(0.016)
Labour x Other	β_{LH}	-0.058	(0.042)	Other x Capital	β_{HK}	-0.008	(0.016)
Other^2	β_{HH}	0.058	(0.042)	Capital^2	β_{KK}	0.067	(0.278)
Labour x Material	β_{LM}	0.126***	(0.049)	Dum83+	α_{1C}	0.078*	(0.044)
Other x Material	β_{HM}	-0.126	(0.049)	Dum86+	α_{2C}	0.269*	(0.052)
Material^2	β_{MM}	-4.856***	(1.595)	Dum94+	α_{3C}	0.269***	(0.052)
Material x Output	β_{MY}	2.453	(0.836)	Dum98+	α_{4C}	0.046	(0.055)
Material x Debt	β_{MD}	0.017	(0.317)	Dum83+	α_{1S}	0.029*	(0.018)
Material x Capital	β_{MH}	0.330	(0.496)	Dum86+	α_{2S}	0.062***	(0.018)
Labour x Output	β_{LY}	-0.078	(0.054)	Dum94+	α_{3S}	-0.034***	(0.013)
Other x Output	β_{HY}	0.078	(0.054)	Dum98+	α_{4S}	-0.025***	(0.018)
AR(1)	ρ	0.735***	(0.077)				
Log likelihood Function		149.407		Schwarz B.I.C.		-89.572	

Note: ***, ** and * refer to 1 per cent, 5 per cent and 10 per cent level of significance, respectively. Figures in parentheses are standard deviations. α_{iC} = coefficients of year dummies for cost function; α_{1S} = coefficients of year dummies for share equations, i=1, 2, 3.

Table 2-9: Nonlinear Parameter Estimates of the System of Equations for the Translog Cost and Share Functions for Federated Co-operative Limited (N=28)

Variables	Parameters	Estimates		Variables	Parameters	Estimates	
Constant	β_0	0.929***	(0.070)	Other x Other	β_{HY}	-0.033*	(0.019)
Labour	β_L	0.444***	(0.013)	Debt x Debt	β_{DD}	-0.003	(0.002)
Other	β_H	0.557***	(0.013)	Labour x Debt	β_{LD}	0.001***	(0.0004)
Output	β_Y	0.516***	(0.165)	Other x Debt	β_{HD}	-.001***	(0.0004)
Debt	β_D	-0.036	(0.025)	Other x Debt	β_{YD}	-0.032	(0.029)
Capital	β_K	-0.111*	(0.065)	Time x Time	β_{TT}	0.596**	(0.254)
Time	β_T	-1.171***	(0.189)	Labour x Time	β_{LT}	0.096***	(0.014)
Labour x Labour	β_{LL}	0.149***	(0.009)	Other x Time	β_{HT}	-.096***	(0.014)
Labour x Other	β_{LH}	-0.149***	(0.009)	Capital x Capital	β_{KK}	-0.114	(0.160)
Other x Other	β_{HH}	0.149***	(0.009)	Labour x Capital	β_{LK}	-.033***	(0.007)
Output x Other	β_{YY}	-1.796	(1.248)	Other x Capital	β_{HK}	0.033***	(0.007)
Labour x Other	β_{LY}	0.033*	(0.019)	Output x Capital	β_{YK}	-0.661*	(0.377)
Debt x Capital	β_{DK}	-0.016	(0.012)				
Log likelihood Function		138.391	Schwarz B.I.C.			-102.490	

Note: ***, ** and * refer to 1 per cent, 5 per cent and 10 per cent level of significance, respectively. Figures in parentheses are standard deviations.

Table 2-10: Nonlinear Parameter Estimates of the System of Equations for the Translog Cost and Share Functions for United Farmer of Alberta (N=28)

Variables	Parameters	Estimates		Variables	Parameters	Estimates	
Constant	β_0	1.097***	(0.130)	Debt x Debt	β_{DD}	0.002***	(0.0004)
Labour	β_L	0.024***	(0.007)	Labour x Debt	β_{LD}	0.0003***	(0.0002)
Other	β_H	0.976***	(0.007)	Other x Debt	β_{HD}	-0.0003***	(0.0002)
Other	β_Y	-0.068	(0.077)	Other x Debt	β_{YD}	-0.002**	(0.001)
Debt	β_D	0.023***	(0.007)	Time x Time	β_{TT}	1.075***	(0.104)
Capital	β_K	-0.178***	(0.048)	Labour x Time	β_{LT}	0.031***	(0.006)
Time	β_T	-1.856***	(0.184)	Other x Time	β_{HT}	-0.031***	(0.006)
Labour x Labour	β_{LL}	0.029***	(0.004)	Capital x Capital	β_{KK}	0.092***	(0.027)
Labour x Other	β_{LH}	-0.029***	(0.004)	Labour x Capital	β_{LK}	0.023***	(0.005)
Other x Other	β_{HH}	0.029***	(0.004)	Other x Capital	β_{HK}	-0.023***	(0.005)
Output x Other	β_{YY}	0.020	(0.018)	Output x Capital	β_{YK}	-0.237***	(0.039)
Labour x Other	β_{LY}	-0.008***	(0.004)	Debt x Capital	β_{DK}	0.008***	(0.001)
Other x Other	β_{HY}	0.008***	(0.004)				
Log likelihood Function	LLF	175.032					
Schwarz B.I.C.		-138.183					
N		30					

Note: ***, ** and * refer to 1 per cent, 5 per cent and 10 per cent level of significance, respectively. Figures in parentheses are standard deviations.

Table 2-11: Nonlinear Parameter Estimates of the System of Equations for the Translog Cost and Share Functions for Saskatchewan Wheat Pool (N=28)

Variables	Parameters	Estimates		variables	Parameters	Estimates	
Constant	β_0	4.955***	(0.512)	Debt x Debt	β_{DD}	-0.097***	(0.034)
Labour	β_L	0.050***	(0.010)	Labour x Debt	β_{LD}	-0.001	(0.002)
Other	β_H	0.950***	(0.010)	Other x Debt	β_{HD}	0.001	(0.002)
Other	β_Y	2.244***	(0.549)	Other x Debt	β_{YD}	0.085	(0.073)
Debt	β_D	0.166	(0.160)	Time x Time	β_{TT}	1.372***	(0.230)
Capital	β_K	-1.512***	(0.257)	Labour x Time	β_{LT}	-0.010***	(0.003)
Time	β_T	-0.652***	(0.103)	Other x Time	β_{HT}	0.010***	(0.003)
Labour x Labour	β_{LL}	0.033***	(0.004)	Capital x Capital	β_{KK}	-0.351***	(0.078)
Labour x Other	β_{LH}	-0.033***	(0.004)	Labour x Capital	β_{LK}	-0.001	(0.002)
Other x Other	β_{HH}	0.033***	(0.004)	Other x Capital	β_{HK}	0.001	(0.002)
Output x Other	β_{YY}	1.122***	(0.301)	Output x Capital	β_{YK}	-0.594***	(0.104)
Labour x Other	β_{LY}	-0.002	(0.004)	Debt x Capital	β_{DK}	0.014	(0.025)
Other x Other	β_{HY}	0.002	(0.004)				
Log likelihood Function	LLF	152.341					
Schwarz B.I.C.		-116.440					
N		28					

Note: ***, ** and * refer to 1 per cent, 5 per cent and 10 per cent level of significance, respectively. Figures in parentheses are standard deviations.

Table 2-12: Estimates of Elasticity of Input Substitutions for AHP and LF

		Alberta Honey Producers Co-operative			Lilydale Foods	
		Labour	Raw	Other	Labour	Other
Quantity	Labour	-12.225***	0.525***	2.436***	-0.708***	0.768***
		(0.584)	(0.203)	(0.464)	(0.185)	(0.172)
	Raw	0.525***	-0.568***	0.969***	--	--
		(0.203)	(0.166)	(0.354)	--	--
	Other	2.436***	0.969***	-2.599***	0.768***	-0.834***
		(0.464)	(0.354)	(0.820)	(0.172)	(0.223)

Note: *** refers to 1 per cent level of significance. Figures in parenthesis are standard deviations.

Table 2-13: Estimates of Elasticities of Substitution for FCL, UFA and SWP

		Federated Co-operative Limited		United Farmers of Alberta		Saskatchewan Wheat Pool	
		Labour	Other	Labour	Other	Labour	Other
				-		-	
Quantity	Labour	-0.3114***	0.3946***	4.785***	0.218***	7.090***	0.351***
		(0.0302)	(0.0546)	(1.867)	(0.087)	(1.956)	(0.104)
	Other	-0.5002***	0.3946***	0.218***	-0.010	0.351***	-0.017**
		(0.0308)	(0.0546)	(0.087)	(0.011)	(0.104)	(0.008)

Note: *** refers to 1 per cent level of significance. Figures in parenthesis are standard deviations.

Table 2-14: Estimates of Price Elasticities of Input Demand for AHP and LF

		Alberta Honey Producers Co-operative			Lilydale Foods	
		Labour	Raw	Other	Labour	Other
Quantity	Labour	-1.067***	0.318***	0.749***	-0.368***	0.368***
		(0.036)	(0.124)	(0.133)	(0.088)	(0.368)
	Raw	0.046***	-0.344***	0.298***	--	--
		(0.018)	(0.099)	(0.111)	--	--
	Other	0.213***	0.586***	-0.799***	0.398***	-0.340***
		(0.038)	(0.213)	(0.241)	(0.087)	(0.036)

Note: *** and ** refer to 1 per cent and 5 per cent level of significance respectively. Figures in parenthesis are standard deviations.

Table 2-15: Estimates of Price Elasticities of Input Demand for Federated Co-operative Limited, United Farmers of Alberta and Saskatchewan Wheat Pool

	Federated Co-operative Limited		United Farmers of Alberta		Saskatchewan Wheat Pool	
	Labour_P	Other_P	Labour_P	Other_P	Labour_P	Other_P
Labour	-0.174***	0.174***	-0.373***	0.373***	-0.209***	0.209***
	(0.017)	(0.029)	(0.094)	(0.086)	(0.082)	(0.084)
Other	0.221***	-0.221***	0.020***	-0.020***	0.010***	-0.010
	(0.031)	(0.017)	(0.007)	(0.005)	(0.004)	(0.011)

Note: *** refers to 1 per cent level of significance. Figures in parentheses are standard deviations.

Table 2-16: Estimates of Output Elasticities of Input Demand

	Alberta Honey Producers Co-operative	Lilydale Foods	Federated Co-operative Limited	Saskatchewan Wheat Pool	United Farmers of Alberta
Labour_Q	0.257*** (0.095)	0.614** (0.231)	0.6876*** (0.105)	0.121* (0.070)	0.081 (0.052)
Raw_Q	0.860*** (0.142)	-- --	-- --	-- --	-- --
Other_Q	0.765*** (0.104)	0.927*** (0.175)	0.554*** (0.123)	0.161* (0.090)	0.126*** (0.054)

Note: *** refers to 1 per cent level of significance. Figures in parentheses are standard deviations.

Table 2-17: Estimates of Returns of Scale by Co-operative (at the mean value)

Case Co-operatives		
Lilydale Foods	1.309***	(0.303)
Saskatchewan Wheat Pool	6.270***	(3.409)
United Farmers of Alberta	8.084***	(3.491)
Federated Co-operative Limited	1.507***	(0.239)
Alberta Honey Producers Co-operative	1.311***	(0.152)

Note: *** refers to 1 per cent level of significance. Figures in parentheses are standard deviations.

Table 2-18: Estimates of Debt Elasticities of Input Demand

	Alberta Honey Producers Co-operative	Lilydale Foods	Federated Co-operative Limited	Saskatchewan Wheat Pool	United Farmers of Alberta
Labour_Q	0.052** (0.025)	-0.172 (0.251)	-0.021 (0.017)	0.021 (0.023)	0.031*** (0.007)
Raw_Q	0.079*** (0.028)	-- --	-- --	-- --	-- --
Other_Q	0.033 (0.028)	-0.230 (0.0.248)	-0.027 (0.017)	0.056* (0.031)	0.030*** (0.007)

Note: **, *** refers to 5 per cent and 1 per cent, respectively, level of significance. Figures in parenthesis are standard deviations.

Table 2-19: Estimates of Debt Elasticity of Variable Cost (Agency Cost)

Year	Alberta Honey Producers Co-operative	Lilydale Foods	Federated Co-operative Limited	Saskatchewan Wheat Pool	United Farmers of Alberta
1975	0.141***	-0.169	-0.021	0.060	-0.041**
	(0.037)	(0.149)	(0.022)	(0.067)	(0.010)
1985	0.030		-0.034	0.141***	0.041***
	(0.021)		(0.024)	(0.037)	(0.009)
2001	0.100***	-0.168	0.017	-0.165***	0.065***
	(0.025)	(0.130)	(0.015)	(0.064)	(0.013)
Mean	0.067***	-0.109***	-0.024	0.055**	0.030***
	(0.018)	(0.046)	(0.017)	(0.030)	(.007)

Note: *, *** refers to 10 per cent and 1 per cent, respectively, level of significance. Figures in parenthesis are standard deviations.

Table 2-20: Test Statistics for the Long run Equilibrium Specification

H_0: The observed capital stock is optimal

Case Co-operative	χ^2-value	DF	Decision
Alberta Honey Producers Co-operative	13.93	6	Reject
Lilydale Foods	10.20	5	Reject
Federated Co-operative Limited	36.99	5	Reject
Saskatchewan Wheat Pool	52.64	5	Reject
United Farmers of Alberta	246.68	5	Reject

Note: Critical χ^2 value at 5 per cent significance level for 5 and 6 degrees of freedom are 11.071 and 12.592, respectively

Table 2-21: Parameters Estimates for the Impacts of Debt and Output on the Divergence between Optimal and Actual Capacity

H_0: Debt has significant impact on Divergence between optimal and actual capacity.

Case Co-operatives	Constant	Debt	Output	R^2
Alberta Honey Producers Co-operative	1.545***	-0.114***	0.162	0.48
	(4.421)	(-4.222)	(1.311)	
Lilydale Foods	2.154*	-0.154**	0.0.169**	0.15
	(1.816)	(-2.012)	(2.054)	
Federated Co-operative Limited	0.023	-0.009***	-0.337***	0.34
	(0.561)	(-3.597)	(-2.866)	
Saskatchewan Wheat Pool	-1.613**	0.061	-0.546***	0.51
	(-2.068)	(1.352)	(-4.382)	
United Farmers of Alberta	1.781***	0.002	0.230*	0.10
	(11.903)	(0.185)	(1.673)	

Note: *, *** refers to 10 per cent and 1 per cent, respectively, level of significance. Figures in parenthesis are t-ratios.

Figure 2-1: Federated Co-operative Structure

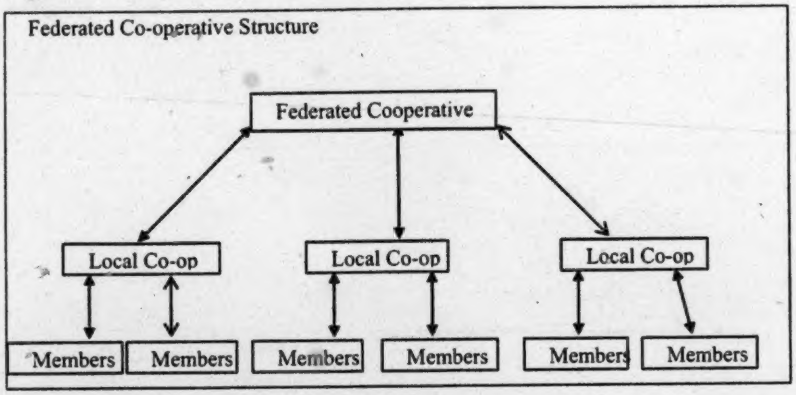

Federated Co-operative Structure
Federated Cooperative
Local Co-op
Local Co-op
Local Co-op
Members
Members
Members
Members
Members
Members

Figure 2-2: Centralized Co-operative Structure

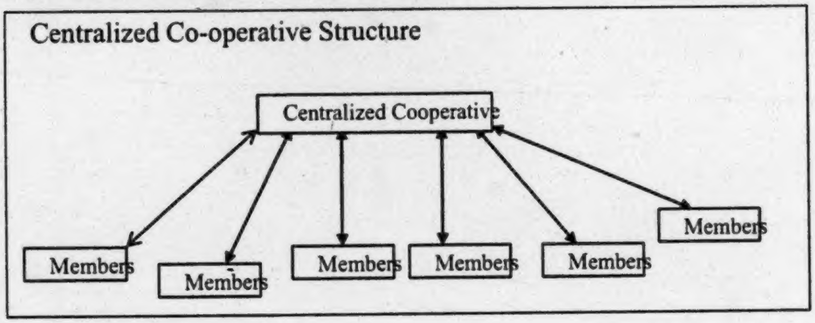
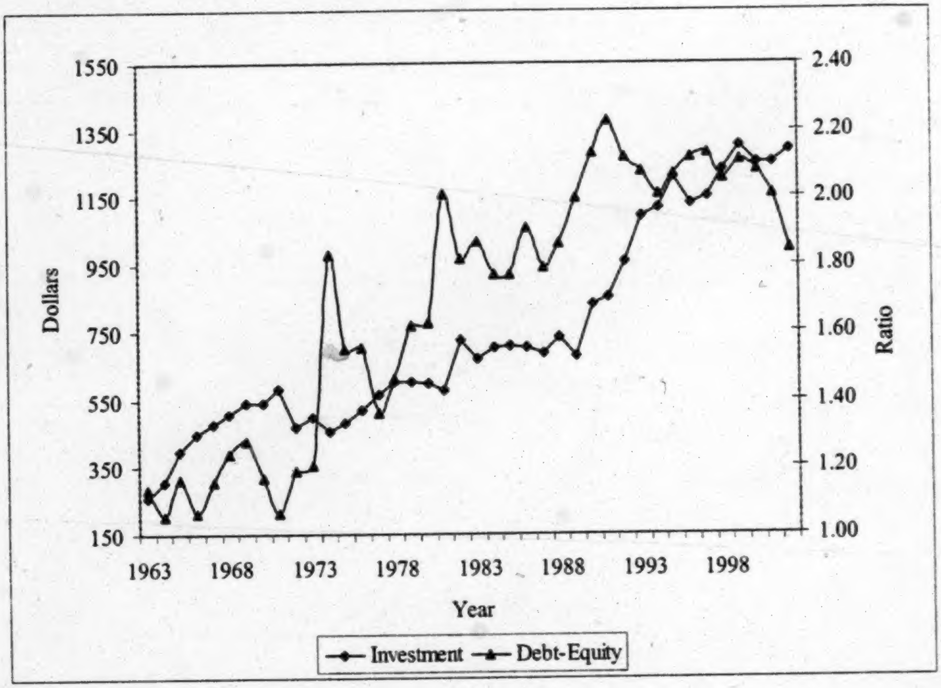
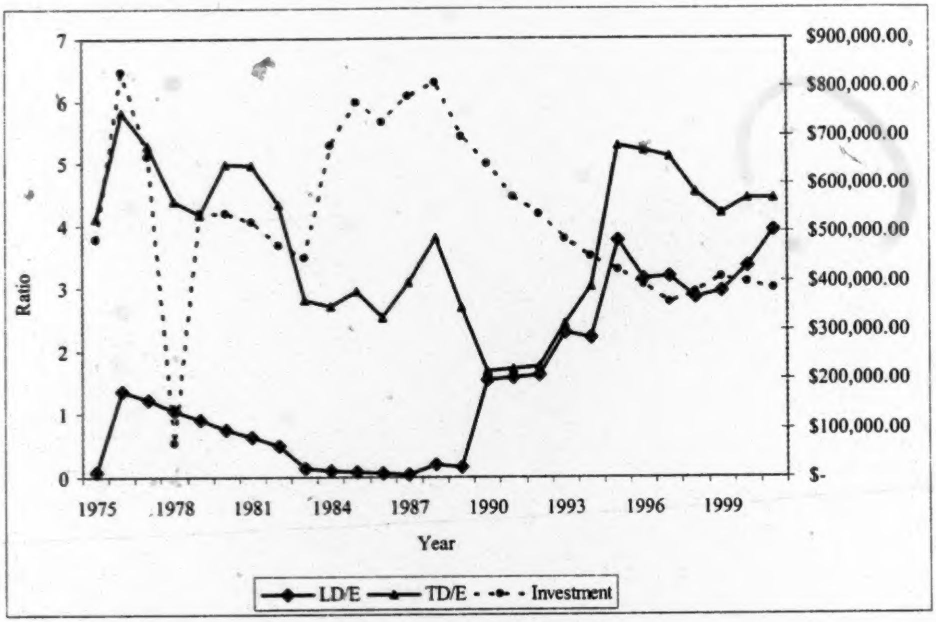

Centralized Co-operative Structure
Centralized Cooperative
Members
Members
Members
Members
Members
Members

Figure 2-3: Real Capital Investments (Million Dollars) and Debt-Equity Ratios for Co-operatives in Canada, 1963-2002 (1992 Dollars)



Source: Co-operative Secretariat: Government of Canada. 1963-2002. Co-operatives in Canada

Figure 2-4: Real Capital Investments and Debt to Equity Ratios for Alberta Honey Producers Co-operative[16]



Data Source: AHP Annual Reports (Alberta Honey Porducers Co-operative, (1973-2001))

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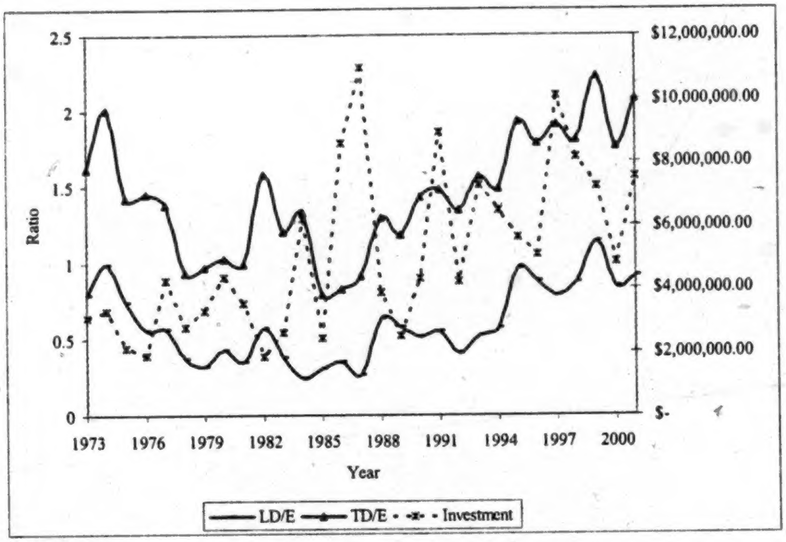
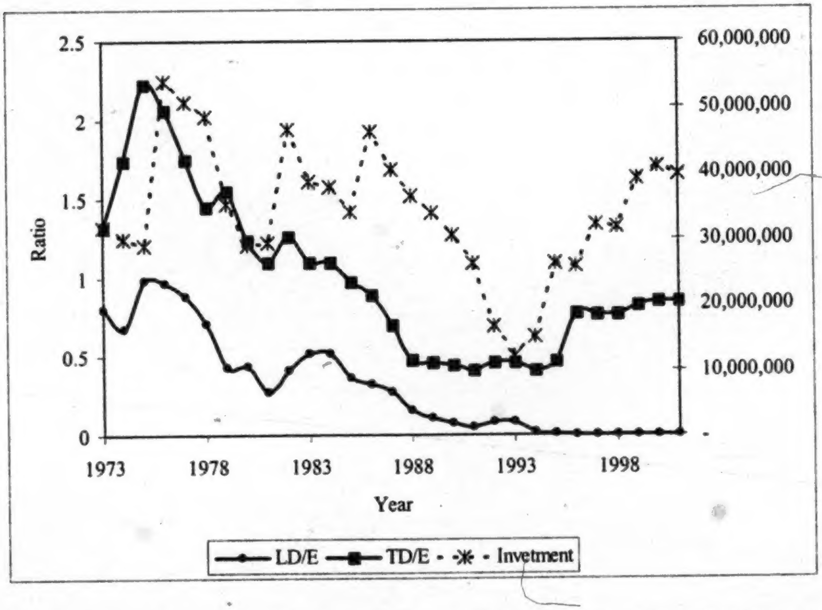
[16] Note: LD/E = Long term debt / Equity; and TD/E= total Liabilities/Equity.

Figure 2-5: Real Capital Investments and Debt to Equity Ratios for Lilydale Foods Co-operative



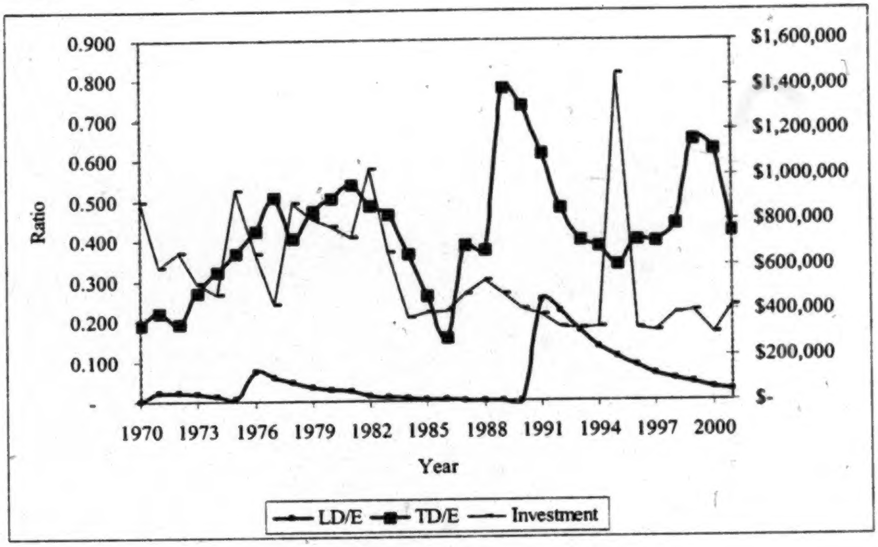
Data Source: LF Annual Reports, (Lilydale Foods, (1973-2001))

Figure 2-6: Real Capital Investments and Debt to Equity Ratios for Federated Co-operative Limited



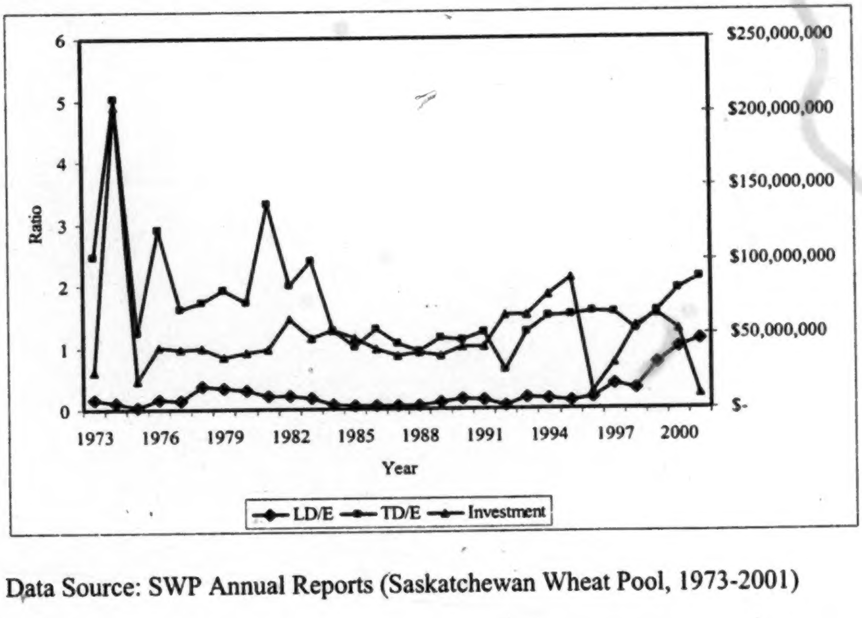
Data Source: FCL Annual Reports (Federated Co-operative Limited, (1973-2001))

Figure 2-7: Real Capital Investments and Debt to Equity Ratios for United Farmers of Alberta



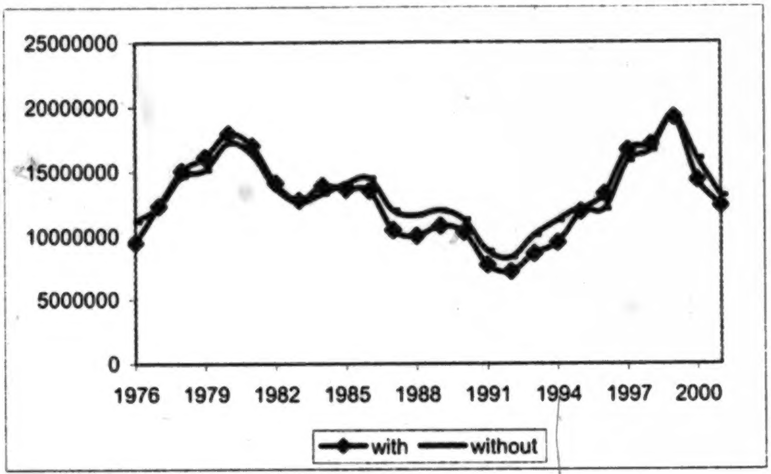
Data Source: UFA Annual Reports (United Farmers of Alberta, (1973-2001))

Figure 2-8: Real Capital Investments and Debt to Equity Ratios for Saskatchewan Wheat Pool



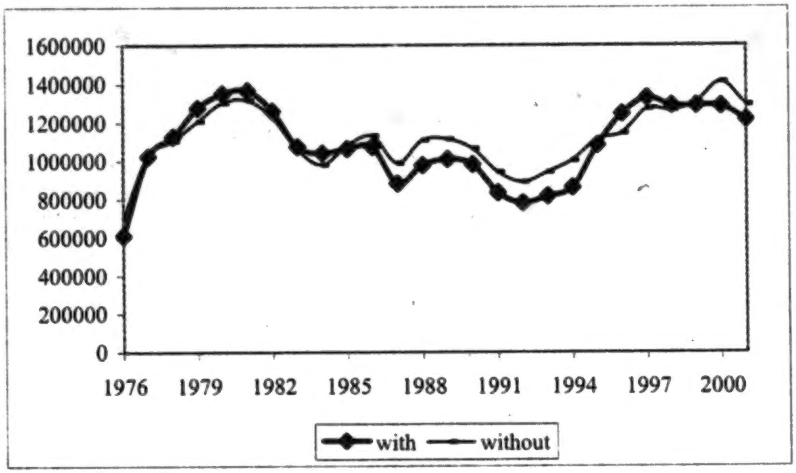
Data Source: SWP Annual Reports (Saskatchewan Wheat Pool, 1973-2001)

Figure 2-9: Impact of Debt Variable Cost of Production for Alberta Honey Producers Co-operative (with and without debt)



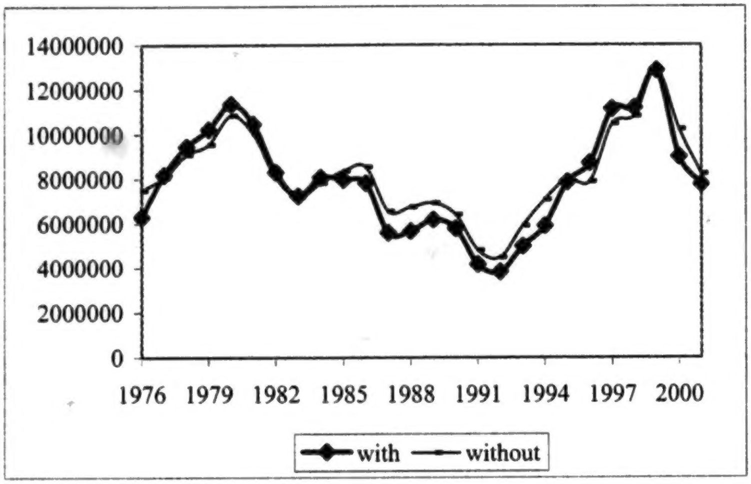
Source: Simulation output

Figure 2-10: Impact of Debt on Labour Costs for Alberta Honey Producers Co-operative (with and without Debt)



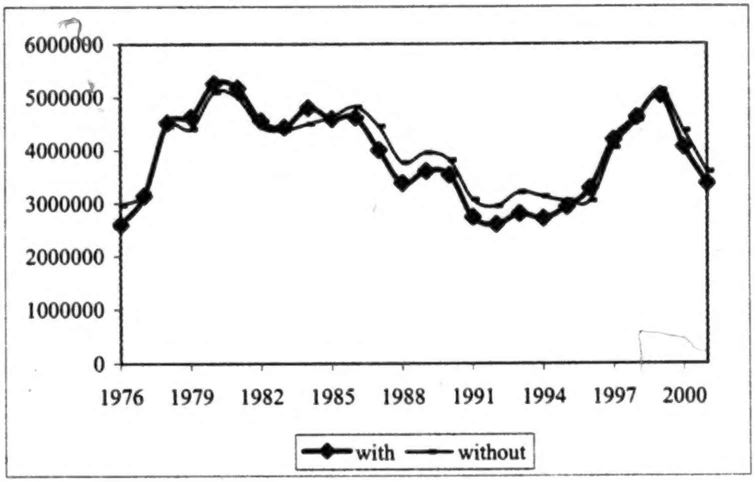
Source: Simulation output

Figure 2-11: Impact of Debt on Raw Materials Costs for Alberta Honey Producers Co-operative (with and without debt)



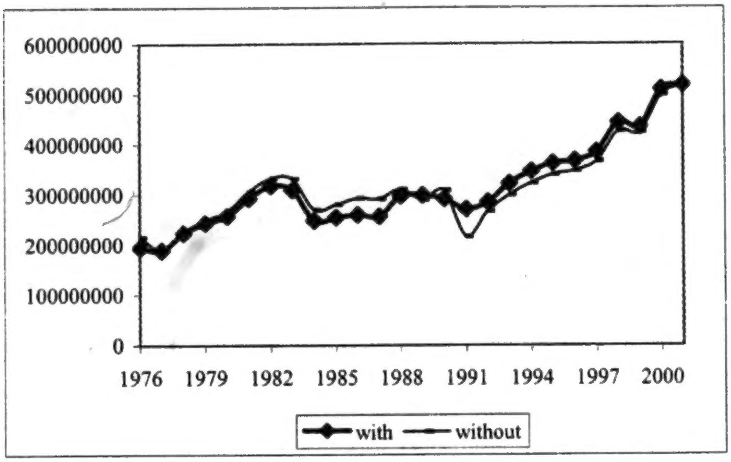
Source: Simulation output

Figure 2-12: Impact of Debt on Marketing Expenses Costs for Alberta Honey Producers Co-operative (with and without debt)



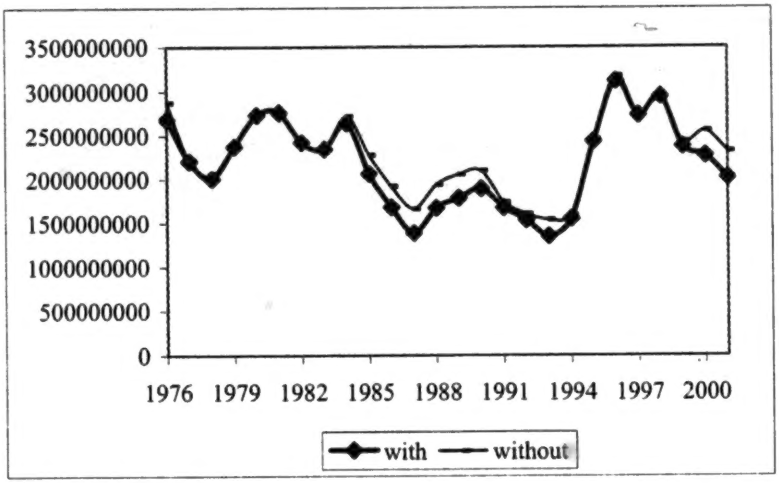
Source: Simulation output

Figure 2-13: Impact of Debt on Total Variable costs of Production ($) for United Farmers of Alberta (with and without debt)



Source: Simulation output

Figure 2-14: Impact of Debt on Total Variable costs of Production ($) for Saskatchewan Wheat Pool (with and without debt)



Source: Simulation output

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Chapter 3: Attitudes of Co-operative Managers and Board Members toward Debt Leveraging Risks and the Impact of Differing Risk Attitudes on Co-operative Performance[1]

3.1 Introduction

Within the finance literature, an assessment of a decision maker's (DM's) financial risk attitude is considered to be an important factor in determining successful business outcomes (e.g., Firth 1995; Weber and Hsee 1998; Barton and Gordon 1988). Agency theory predicts that conflicts between owners and managers can arise because of differences in their attitudes towards risks (Eisenhardt, 1989). Because of different risk preferences, managers and directors may prefer different actions. Thus, risk attitude incompatibility may impede overall efficiency of resource use. Although decision makers undoubtedly differ in their risk attitudes, previous studies have not attempted to empirically scrutinize the impact of risk attitude differences on co-operative business performance.

The potential conflicts between managerial self-interest and self-interests of the firm's owners (Jensen 1986; Jensen and Meckling 1976) and the impact of these differences on the choice of capital structure (Friend and Lang 1988; Firth 1995; Matthews et al 1994) have been acknowledged by many researchers. Despite the considerable literature in this area (e.g., Jensen and Meckling 1976; Lewis and Sappington 1995), the impact of differences in risk attitudes between managers and directors/members on the decision making process has remained a relatively unexplained aspect of agency problems, especially in member-owned firms. In this regard, any information concerning the risk attitudes of managers and directors (BODs) for co-operative businesses is useful in identifying potential sources of conflict in decisions regarding training, personnel selection, financing decision, communication, and placement. Furthermore, assessment of risk attitudes for managers and directors may have important implications for the designing and selection of financial risk management strategies/policies and the performance/success of co-operative businesses. Among other things, the process of risk management[2] is likely affected by the risk attitude of business decision makers (DMs) (Tufano, 1998).

This study assesses the social psychological and demographic variables that affect co-operative decision makers' attitudes towards long term debt financing, investment risk and willingness to pay for lottery and their intentions to increase long-term borrowing. The degree to which differences in risk attitudes exist between co-operative managers and directors is explored. The impact of managers' and directors' attitudes towards debt on their intention to borrow additional debt is also examined.

The objectives of the study are (i) to investigate whether attitudes towards long-term borrowing, attitudes towards risky investment and willingness to pay for lottery differ between co-operative business managers and directors; (ii) to illustrate the impact of attitudes towards borrowing, subjective norm, perceived behavioural control and demographic variables on manager's and directors' behavioural intention to approve additional long term borrowing (or debt policy); (iii) to investigate the familiarity of managers and directors of co-operatives with different risk management strategies; and iv) to explore the impact that risk attitudes and decision making power divergence between managers and directors might have upon firm performance.

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[1] Versions of this chapter have been published. Hailu, Goddard, and Jeffrey. 2005. CARI: A Journal of the Canadian Agricultural Economics Society. 6:63-80. and Hailu, Goddard and Jeffrey. 2005. In Theresia Theurl, Eric Christian Meyer (eds): Strategies fo Cooperation, Aachen 2005, pp. 347-384.

[2] Risk management may be defined as choosing among alternative strategies to reduce risks.

3.2 Literature Review

Previous studies have investigated risk attitudes for a variety of different classes of DMs, using different methods, and examining a number of different issues (Chavas and Holt, 1990; Antle, 1987; Saha et al., 1994; Pennings and Smidts, 2001; Pennings and Leuthold, 2000; Lence, 2000; Pennings and Garcia, 2001; Roosen and Hennessy, 2003; Meuwissen et al., 1999; Brockhaus, 1980). For example, Brockhaus (1980) studied the relationship between entrepreneurial decision and risk. Johnson and Powell (1994) and Olen and Cox (2001) examined the relationship between risk attitudes and gender. Pennings and Smidts (2001) assessed the relationship between risk attitude and market behaviour. MacCrimmon and Wehrung (1986b) explored the relationship between risk attitudes of business executives and age, income, education as well as other personal and business characteristics.

Other studies have looked at the impact of firms' risk-taking attitudes on advertising budgets (Lee, 1994) and found that a firm's previous poor performance leads to its risk-taking behaviour, which in turn leads to the firm's spending more on advertising. Walls and Dyer (1996) examined risk propensity and firm performance in the petroleum exploration industry. Their results indicated that decisions about corporate risk policy have a significant impact on the petroleum firm's economic performance and there may exist an optimal strategy for risk taking which leads to high returns and low ex post risk. For the petroleum industry, Walls (2004) as well investigated the relationship between corporate risk-taking and performance. The results indicated that those firms who behave in a highly risk averse manner generate less than superior asset returns while those who revealed a relatively high risk propensity, compared to their competitors, generate significantly higher asset returns. In a different study, Ruchala (1999) explored the influence of budget goal attainment on risk attitudes and escalation. Ruchala found that individuals make riskier investment decisions when they are not achieving budget goals.

In terms of Canadian co-operative businesses, relatively little is known about the risk attitudes of decision makers within these organizations. Additionally, no study has explicitly explored the impact of divergence in risk attitudes of managers and directors on business management decisions such as selection of financial risk management strategies and capital structure. Manager /director degree of risk-aversion might have important implications for the level of debt financing risk exposure. Different attitudes can affect negotiations between directors and managers and potentially lead to conflict.

3.3 A Behavioural Conceptual Framework

One of the conceptual challenges related to the study of DM's behaviour under risk is the measurement of risk preferences or attitudes. Precision of measurement is contingent upon the assumptions made regarding the decision criteria used to evaluate risk. In the literature, there are different types of risk attitude measurement approaches. In economics, it is common to use models derived from the expected utility framework (von Neumann and Morgenstern, 1947; Schoemaker, 1982; Fishburn, 1988). In the field of health and social sciences the theory of planned behaviour has been widely used to quantify individuals' attitude, behavioural intention and actual behaviour (Ajzen, 1991). A related approach derived from the theory of planned behaviour is Fishbein's (1963) multi-attribute model.

These theoretical models are based on the assumption that human beings are rational and make systematic use of the information available to them (von Neumann and Morgenstern, 1947; Ajzen and Fishbein, 1980). All take the view that individual decision-making involves some kind of utility calculation. The theory of expected utility accounts for the interdependence of actions whereas the theory of planned behaviour looks at human behaviour at a much more disaggregated level. In this case, these approaches may be considered as complementary to each other. In the following section, each of these theories is discussed in broad terms.

The theory of planned behaviour not only assesses the attitude towards an object but also deals with subjective norms, perceived behavioural control and behavioural intention of individuals[3]. Attitude towards an object, perceived behavioural control and subjective norms, according to Ajzen (1991), independently lead to behavioural intention and ultimately an action or a choice. This framework is used to investigate the impact of attitude towards debt financing, perceived behavioural control and subjective norm on intention to borrow. Intention to borrow will ultimately lead to the choice of the actual capital structure choice. The rest of this section is organized as follows. In section 3.3.1, the expected utility (EU) model is introduced. The theory of planned behaviour is presented in section 3.3.2.

3.3.1 The Expected Utility Theory

Expected utility (EU) theory is one of the commonly used economic models to assess individuals' risk attitudes. The EU model has provided the basis for most of the research on the economics of risk (Friedman and Savage, 1948). EU theory is largely based on the contributions of von Neumann and Morgenstern (1947). EU theory views decision making under risk as a choice between risky prospects (Pennings and Garcia, 2001). A risky prospect refers to an act or a possible choice that has a probability distribution of outcomes. EU theory is a hypothesis concerning individual preferences for alternative probability distributions over wealth (von Neumann and Morgenstern, 1947). It states that choices made under uncertainty are affected by the DM's preferences and expectations (King and Robison, 1981). In maximizing expected utility a DM assigns utility value to the outcomes of random events and selects the strategy with the highest expected utility (Johnson and Boehlje, 1983). In the expected utility framework, a DM's risk attitude is derived from the assessment of a utility function u(x). Algebraically, if the random variable $\tilde{x}$ describing the prospect outcome has a distribution F(x), then,

if a density function exists:

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[3] Attitude is an individual's positive or negative evaluation of behaviour. Subjective norm is an individual's perception of social pressure. Perceived behavioural control is a reflection of perceived ease or difficulty involved in performing behaviour.

$$U(\bar{x}) = E[u(x)] = \int_{-\infty}^{\infty} u(x)f(x)dx \qquad (3\text{-}1)$$

and if the probability space is discrete,

$$U(\bar{x}) = \sum_{i=0}^{\infty} u(x_i)\Pr(i) \qquad (3\text{-}2)$$

where U(.) is the expected utility function or the von Neumann-Morgenstern utility, while u(.) is the ordinary utility function.

The expected utility theorem states that if the axioms of ordering and transitivity, continuity, and state independence hold for the DM's behaviour, this necessarily implies the existence of both a utility function that reflects the DM's preference for consequences and a subjective probability distribution that reflects the DM's judgement about the chances faced by the DM (Anderson et al., 1977).

In the expected utility framework, once the utility function is specified the next step is to investigate the behavioural implication (i.e., risk preferences) based on its shape (i.e., curvature). Pratt (1964) and Arrow (1971) have shown that the degree of local risk aversion for an expected utility function u(x) depends on the ratio of curvature and the slope; that is,

$$r_A(x) = \frac{-u''(x)}{u'(x)} \qquad (3\text{-}3)$$

where $r_A(x)$ is the Pratt-Arrow absolute risk aversion function, $u''(x)$ is the curvature the and $u'(x)$ is the slope of a von Neumann-Morgenstern utility function u(x). An important property of the Pratt-Arrow absolute risk aversion function, from the perspective of modeling behaviour, is that it is a unique measure of risk preferences, whereas a utility function is unique only to a positive linear transformation.

Given a set of behavioural assumptions, actual behaviour under risk is necessarily consistent with expected utility maximization. However, when the assumptions of the expected utility model are violated, the validity of the expected utility model and the resulting empirical tools have been questioned (Lichtenstein and Slovic, 1973; Lichtenstein and P. Slovic, 1971; Loomes and Sugden, 1982; Bell, 1982; Fishburn, 1982).

3.3.1.1 Stochastic Dominance

One of the empirical tools derived from EU theory is Stochastic Dominance (SD). To systematically analyze the risk attitude of the DMs, SD (Hadar and Russell, 1969; Hanoch and Levy, 1969; Rothschild and Stiglitz, 1970; Levy, 1992) is applied in this study. The theoretical attractiveness of SD lies in its nonparametric orientation in that it does not require a full parametric specification of the DM's preferences (i.e., a utility function). Instead, SD relies on general preference assumptions to identify conditions under which one risky outcome would be preferable to another (Hadar and Russell, 1969; Hanoch and Levy, 1969; Rothschild and Stiglitz, 1970; Levy, 1992). The basic approach of SD is to resolve risky choices while making the weakest possible preference assumptions. Generally, SD assumes that an individual is an EU maximizer and then adds further assumptions relative to preference for wealth and risk aversion (e.g., two alternatives are to be compared and these are mutually exclusive).

Associated with different preference assumptions, SD includes a number of different criteria including First-Order SD (FSD), Second Order SD (SSD), and Third Order-SD (TSD). FSD assumes more is preferred to less, or non-satiation. SSD adds the assumption of risk aversion or concave utility function, and TSD requires an additional assumption of decreasing absolute risk aversion. In this study, the SSD criterion is used to assess managers and directors risk attitudes.

3.3.1.2 Willingness to Pay for Lottery Ticket

Another empirical application of EU theory is willingness to pay for lottery tickets. The lotteries can be represented by a simple list of pairs as: $L=[x,\alpha; 0,(1-\alpha)]$ where α is a chance of winning a money prize of x and $(1-\alpha)$ is the chance of winning nothing. The lottery implicitly assumes that individuals make choices between two alternatives of the form (x, α) and $(0, 1-\alpha)$. The expected utility of such an alternative is $\alpha u(x)+(1-\alpha)u(0)$, where u is the utility function of money. The individual is expected to select the alternative with greater expected utility value. Hence, the individual is expected to pay more for a lottery with a higher expected utility.

3.3.2 Social Psychological Theory

3.3.2.1 Theory of Planned Behaviour

With its foundation in social psychology literature, the theory of planned behaviour is the most widely used model to describe and measure the DM's attitudes towards an object, behavioural intention and behaviour. The theory states that behaviour can be predicted if observers know (i) the individual's attitude towards a particular behaviour, (ii) the individual's intention (behavioural intention) to perform the behaviour, (iii) what the person believes are the consequences of performing that behaviour and, (iv) the social norms which govern that behaviour (Ajzen, 1991). Basically, the theory of planned behaviour (Fishbein and Ajzen, 1975a) states that human behaviour is determined by the formation of prior intentions, and that intentions are formed on the basis of a weighted combination of attitudinal and normative factors. According to Ajzen (1991) an individual DM's behavioural intention (BI) is affected by the attitude (A) towards the behaviour, subjective norm (SN) and perceived behavioural control (PBC). SN refers to approval of a person's important referents with regard to the consequences of performing the behaviour or not. PBC refers to the degree to which a person feels that his or her performance or non-performance of the behaviour is under his or her control (Ajzen, 1991).

The individual's intention to perform a given behaviour (e.g., intention to increase debt capital) is a central construct in the theory of planned behaviour and reflects how individuals are motivated to try to perform the behaviour in question (Ajzen, 1991). PBC can be best explained as individuals' confidence in their ability to perform a given behaviour. The theory of planned behaviour suggests that PBC has an impact both on the BI to perform the behaviour and the behaviour (B) per se. As can be seen from Figure 3-1 behavioural achievement is a function of intention to perform and behavioural control (or ability to perform the behaviour). Figure 3-1 depicts the relationship between intention and behaviour.

Empirically, attitudes towards actions (e.g., leveraging) are determined by and can be measured as the sum of evaluative salient behavioural belief, where behavioural beliefs are beliefs held about the consequences of the action in question. The basic form of the Fishbein multi-attribute attitude model can be expressed as:

$$A_j = \sum_{i=1}^{n} b_{ij} e_i \qquad (3\text{-}4)$$

where A_j is an individual's attitude towards an object j (e.g., debt leveraging); b_{ij} is the individual's belief, expressed as a subjective probability that object j is associated with some attribute i; e_i is the evaluative aspect (i.e., judged goodness or badness) of attribute i; and n is the number of salient beliefs. Equation (3-4) represents a model of attribute measurement wherein an individual's beliefs about a particular attribute object are weighted and summed to yield an index of overall attitude. It is assumed that a person's attitude towards the behaviour is proportional ($\propto$) to the summative index (Ajzen, 1991), as illustrated in Figure 3-1.

Subjective norm (SN) is obtained as the sum of the product of the strength of each normative belief (nb) and the motivation to comply (mc) with the referent in question over the n normative beliefs. It is assumed that a person's subjective norm is proportional ($\propto$) to the summative index. Thus, subjective norm can be expressed as:

$$SN = \sum_{i=1}^{n} nb_i mc_i \qquad (3\text{-}5)$$

where nb_i is the DM's normative belief that the salient reference thinks he/she should (or should not) perform the behaviour and mc_i is the DM's motivation to comply to that referent (Ajzen and Fishbein, 1980a).

Perceived behavioural control (PBC) is among the beliefs that ultimately determine the behavioural intention and behaviour/ action. To obtain a measure of PBC, each control belief (cb) is multiplied by perceived behavioural facilitation (pf) of the particular control factor to facilitate or inhibit performance of behaviour, and the resulting products are summed across the n salient control beliefs to produce the perception of behavioural control (PBC); that is,

$$PBC = \sum cb_i pf_i \qquad (3\text{-}6)$$

Finally, the motivational factors that influence behaviour are assumed to be captured by intention to perform a given behaviour. Intentions are the indications of how much of an effort the DMs are planning to exert in order to perform the behaviour. Behavioural intention represents the person's motivation to perform the behaviour in question.

In summary, according to equation (3-4), (3-5), (3-6), and Figure 3-1 the DM's behavioural intention is guided by attitude towards behaviour (behavioural belief), subjective norm (normative belief), and perceived behavioural control (control belief). Behavioural intention is a combination of attitude towards the behaviour (A_j) defined in equation (3-4), subjective norm (NS) defined in equation (3-5) and perceived behavioural control (PBC) as defined in equation (3-6). These theoretical constructs are latent or theoretical variables in that they cannot be directly observed but must be inferred from observable responses. The theory of planned behaviour can be used to organize the key concepts of behaviour and predict behaviour (e.g., debt financing). Once the information on attitude towards risk or debt capital, subjective norm, and perceived behavioural control is obtained, the next step is to investigate which of the three is the best predictor of intention to increase/decrease debt capital; that is,

$$BI = \alpha_1 A + \alpha_2 SN + \alpha_3 PBC \qquad (3\text{-}7)$$

which can be expressed in terms of multiple regression as follows:

$$BI=\alpha_0+\alpha_1A+\alpha_2SN+\alpha_3PBC+\varepsilon \qquad (3\text{-}8)$$

To obtain information on A, SN and PBC, both direct measures and belief-based measures are used. In the literature, the theory of planned behaviour has been modified to include individuals' previous habits or behaviour and socio-demographic variables. Using the Fishbein and Ajzen approach, Bentler and Speckart (1979) extended the Fishbein and Ajzen model by incorporating past behaviour and subsequent behaviour (Figure 3-2).

The behavioural model is also versatile in accommodating socio-demographic variables. Identifying differences in attitudes attributable to the DMs' gender, age, manager-director, income, education, awareness of risk management practices, is an important objective of the study (Figure 3-3).

3.3.2.2 Fishbein's Multi-attribute Attitude Model[4]

Fishbeins multi-attribute attitude model deals with one aspect of the theory of planned behaviour. In this framework, Fishbein and Ajzen (1975) define attitude as a learned predisposition to respond in a consistently favourable or unfavourable manner regarding a given object or concept. Fishbein's multi-attribute model (Fishbein, 1963; Fishbein and Ajzen, 1975b) provides the theoretical underpinning for an assessment of a DM's overall attitudes towards the negative and positive attributes of increasing long-term borrowing, for example. This multi-attribute model provides a useful framework because it views the multiple characteristics (attributes) associated with an object (e.g., increased borrowing) as important elements shaping a DM's attitude towards that object. The basic form of the belief-based (Ajzen, 1991) multi-attribute model is given in equation (3-4).

To obtain estimates of individuals' attitudes, Ajzen (1991) has suggested using both direct and belief-based measures that are based on responses to selected questions. For the Fishbein's multi-attribute approach the direct measure is adopted for use in this study.

3.4 Method: Data and Measurements

3.4.1 Sampling and Data Collection

Agricultural marketing and supply co-operatives in Alberta, Manitoba, Saskatchewan, Ontario, British Columbia and Quebec are the target population of the study. These provinces are chosen because of the higher prevalence of agricultural marketing and supply co-operatives. In the literature, there are several ways that the appropriate sample size be determined. However, in this study all agricultural marketing and supply co-operatives in the above provinces were contacted, either by mail or by fax before the actual survey. This first contact explained the research and its importance for the co-operative sector and also requested their willingness to participate in the survey (see Appendix A). Some of the co-operatives were also contacted by telephone. Approximately 426 such letters were sent out. Of the 426 co-operatives, only 17 co-operatives were willing to participate, respectively, a response rate of only 4 per cent. In the second stage, questionnaires were sent to the 17 co-operatives to distribute to the members of the management team and board of directors. To the 17 co-operatives, 139 survey questionnaires were sent by direct mail. Because of the particular interest in potential differences in the risk attitudes of managers and directors, both groups of decision makers were included in the survey. The 'indirect'[5] mail method used in this study solicited responses from a total 30 co-operative managers and directors (see Appendix C, E and G). Reminder mails were sent to the participating co-operatives (see Appendix I). Reminder phone calls were also made. Completed questionnaires were returned by 30 of the 139 managers and directors for a direct mail response rate of 20 per cent. Given the two stage nature of this survey, this response rate is unsatisfactory and the results may not be conclusive but are potentially useful for future research directions. Table 3-1 presents survey response at different stages.

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[4] Note that the Fishbein multi-attribute attitude model is nested within the theory of planned behaviour.

The main purpose of the questionnaire is to elicit the risk attitudes of the members of the management team and members of the board of directors. The actual questionnaire used for the study is provided in Appendix G, and consists of questions addressing the following areas:

1. Overall financial risk attitude elicitation;
2. The theory of planed behaviour based risk attitude elicitation;
3. The expected utility theory based risk attitude elicitation;
4. Risk management practices and perceived importance of risk management;
5. General business information; and
6. Demographic information

Information on frequency of previous gambling activities and self-ratings is also gathered. Some of the questions used in the questionnaire are reproduced and discussed in the following sections.

In the following section, data obtained on the EU and TpB framework are described. First the EU based risk attitude elicitation procedures and data are presented and discussed. The empirical data for the EU approach are based on stochastic dominance and willingness to pay techniques. Second, the survey data based on TpB are presented and discussed. Third, data based on Fishbein's multi-attribute model are presented. Finally, in section 3.5, individual characteristics are presented.

3.4.2 The Expected Utility Method

Explicit modeling of the EU hypothesis requires explicit information about the DM's preferences. There are various empirical procedures available to elicit DM's risk preferences or behaviour: certainty equivalent methods (ELCE/ELRO) (Anderson et al., 1977); interval approach (King and Robison, 1981); tradeoff method (Wakker and Deneffe, 1996; Fennema and van Assen, 1998); the probability equivalent method (Kahneman and Tversky, 1979; Kahneman and Tversky, 1992); the Ramsey method (Khanthavit et al., Undated), and the stochastic dominance approach (Levy and Levy, 2001), among others. The diverse range of alternatives to measure the DM's risk attitudes may be indicative of the fact that attitudes are difficult to measure accurately enough to permit the reliable evaluation of alternative choices. Many of these approaches require experimenting through the use of interviews and are therefore too costly to undertake. In this study, the stochastic dominance and WTP for lottery approaches are used because they can easily be implemented through the use of survey methods.

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[5] Direct mails were sent to the co-operatives. The contact persons in each co-operative distributed the questionnaires to the participants.

3.4.2.1 e Stochastic Dominance

The second-order stochastic dominance[6] approach is implemented to assess whether the DM's utility functions are concave or convex. To do so, individuals are asked questions regarding choices between alternatives in which both positive and negative outcomes are possible. This enables one to "experimentally" elicit whether individuals can be generally characterized by risk aversion or risk taking behaviour (Levy and Levy, 2001). As discussed by Levy and Levy (2001), and McCord and de Neufville (1986), to avoid the certainty effect[7], all alternatives are uncertain. To circumvent the problem of a subjective probability distortion, which occurs for small probabilities, all probabilities are relatively large (Levy and Levy, 2001). In this approach the elicitation of risk attitudes is based on the information in Table 3-2.

The response for Scenario I is used to test the degree to which respondents are rational in the sense that they prefer more to less (Figure 3-4). Figure 3-4 depicts the cumulative distribution corresponding to the two business alternatives in Scenario I. In Scenario I, A dominates B by FSD. Responses for Scenario II are used to directly assess the risk attitudes of the respondents. By second-degree stochastic dominance, any risk-averse individual should prefer B to A (Figure 3-5).

Table 3-3 summarizes the outcomes of the two business investment scenarios in terms of expected value and variance. In Scenario I, although both A and B have equal variances, business A's expected payoff is higher than that for B. Under Scenario II, both A and B have equal expected payoffs, but business B has greater volatility (i.e., business B is more risky).

3.4.2.2 Willingness to Pay for Lottery Tickets

With the willingness to pay approach to modeling the EU theory, co-operative managers and directors are asked to state their reservation price (i.e., risk premium) for a lottery ticket after the chances of winning a prize of a particular magnitude are specified. Laffont (1989):p.19) states that

> *[t]he risk premium is the maximum amount that the agent is willing to pay to have the sure return rather than the expected return from lottery ticket.*

One advantage of this approach is its simplicity and low cost since it can be implemented through questionnaires that are distributed to respondents through mail, as is the case in this study. Risk attitudes based on the willingness to pay are calculated as follows (Hartog et al., 2000; Brunello, 2002) :

$$\rho_{ik} = \frac{(\alpha_k X_k - WTP_{ik})}{(WTP_{ik}^2/2 + \alpha_k X_{ik}^2/2 - \alpha_k WTP_{ik} X_k)} \qquad (3\text{-}9)$$

where ρ_{ik} is the (implied) Arrow-Pratt measure of absolute risk aversion for the i-th DM for the k-th lottery, X_k is the prize of the k-th lottery, α_k is the probability of winning the k-th lottery, WTP_{ik} is the maximum price that the i-th individual is willing to pay for the k-th lottery (i.e., the reservation price). An individual with utility $u_1(x)$ is more risk averse than the individual with utility $u_2(x)$ if for all $x : \rho(x, u_1) \geq \rho(x, u_2)$. For $WTP=0$, $\rho=2/X$, for $WTP=\alpha X$ (risk neutrality), $\rho=0$, and for $WTP=X$ (risk loving), $\rho=-2/X$. By eliciting the 'degree' of an individual's risk aversion, information from this approach may supplement the results that are obtained using the stochastic dominance method.

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[6] Note that the survey method used in this study differs from the interactive method used by most researchers to obtain risk attitudes of DMs.

[7] The certainty effect refers to the situation whereby "people overweight outcomes that are considered certain, relative to outcomes that are merely possible." (Kahneman and Tversky 1979: 265).

In the above scenario (Table 3-4), all other things being equal, the greater the sum of money the respondent is willing to pay under each lottery game, the lower the degree of risk aversion. Although Lottery I and II have equal payoffs, the chance of winning is different. The chance of winning Lottery I is 10 per cent while the chance of winning Lottery II is 20 per cent with expected payoffs of $10 and $20, respectively. Intuitively, it can be argued that the willingness to pay for Lottery II should be higher than that for lottery I. The relationship between other combinations may also be discussed in the same fashion.

3.4.3 Social Psychological Methods

3.4.3.1 Theory of Planned Behaviour

A social psychological approach (TpB) is also adopted to explore the DM's risk attitudes, intention and behaviour concerning financing investment expansion using debt. This approach extends Fishbein's multi-attribute model by including intention and behaviour, in addition to attitude. As mentioned earlier, the theory of planned behaviour states that human behaviour/intentions are guided by attitude towards the behaviour (debt), subjective norm (perceived social pressure), and perceived behavioural control (ability to affect company decisions) (Figure 3-1: page 10). In the socio-psychological approach, attitude towards debt financing risk is a latent variable whose "value" is inferred by answers to multi-scale questions.

To obtain information on attitudes towards the impact of an increase in long-term borrowing on financial risk exposure, respondents were given the following hypothetical business set-up.

> *A company that is planning to expand by 10 per cent over the next two years in order to survive competitive pressure is assumed. The expansion should be financed by either debt capital or equity, or both over the same period.*

Table 3-5 provides the background information for this scenario. The above hypothetical business expansion plan is designed to obtain insights into attitudes of co-operative managers and directors towards financial risk exposure (i.e, debt leveraging risk exposure) and their perceptions of appropriate or 'optimal' capital structure. The pre- and post-expansion capital structure outcomes for this hypothetical business, with different financing scenarios, are provided in Table 3-6. The debt-to-equity ratio is a measure of the extent to which the creditors have financed the business, compared to the owners. The greater the proportion of financing provided by creditors, the higher the value of the ratio[8]. The desired value of the ratio will depend on the industry/firm type and the resulting income variability of the business as well as other factors, such as the risks associated with production. For example, a farm business with high-income variability such as grain, beef or hogs would want to achieve a ratio significantly less than 1. Given the initial situation of this hypothetical business, any additional borrowing may aggravate the financial risk exposure under poor economic conditions.

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[8] Theoretically, there is no upper limit for this ratio but any business with too much leveraged capital certainly runs the risk of 'loss.' The desired value of the ratio will depend on business type and the resulting income variability of the business as well as other factors, such as the risk associated with production and prices. Businesses with high-income variability may want to achieve a ratio significantly less than one.

Based on the above business scenario, questions to elicit behavioural intention, attitudes, subjective norms and perceived behavioural control are framed. Items were generated to assess all constructs specified in the TpB: behavioural belief and outcome evaluation (eight items each); normative belief and motivation to comply (seven items each); control beliefs and perceived power (thirteen items each). Responses to all items were rated on 7-point scales.

3.4.3.1.1 Behavioural Intention Assessment

The actual behaviour of the DMs is elicited using responses to a set of questions related to their intentions. This is based on the assumption that behaviour is the direct reflection or manifestation of the DM's intentions. The survey questionnaire contains five items that are used to assess respondents' behavioural intentions, BI_i, to increase or decrease debt capital for the proposed 10 per cent business expansion over the next two years. Two questions that are designed to provide a measure of intention to increase long-term borrowing contain the following statements:

> *(1) During the next two years I will approve additional borrowing to finance investment in the company. (2) I intend to approve additional borrowing to finance new investments in the company over the next two years.*

These items are followed by a choice of eight possible responses: "very unlikely, unlikely, somewhat unlikely, neutral, somewhat likely, likely, very likely, no opinion." Higher values for these two items indicate elevated intentions to borrow money. Two questions that are used as measures of intention to increase debt capital contain the following conditional intention questions:

> *(1) If you were told that higher level of debt leads to higher returns to equity because of tax-benefits, how would it affect your intention to finance the proposed expansion using 100 per cent long-term debt? (2) If you were told that the costs of borrowing are low, how would it affect your intention to finance the proposed expansion using 100 per cent long-term debt?*

Higher values for these two items also indicate elevated intentions to borrow money. These items are followed by a choice of eight possible responses: "would not borrow, not inclined to borrow, less inclined to borrow, neutral, inclined to borrow, more inclined to borrow, would borrow, no opinion." The last item is:

> *During the next two years additional investment should be financed solely through equity capital.*

This item is followed by, "always, most of the time, often, never." Higher values for this item indicate lower intentions to borrow.

3.4.3.1.2 Attitude towards Behaviour

As suggested by Ajzen (2002), a 7-point bipolar adjective scale is used to elicit respondents' direct attitudes about business expansion through increased debt capital. Eight questions were asked to measure attitudes towards debt. A sample question to measure attitudes directly is given in Table 3-7.

This question is asked six times, using different adjectives. Attitude toward increased borrowing is also elicited using the belief-based approach. For each belief, the outcome evaluation and belief strength are obtained and multiplied as outlined in equation (3-10). Eight items each for outcome evaluation and belief strength are used. Table 3-8 presents the sample question that is used to elicit outcome evaluation and belief strength. If the respondent chooses "very good" for outcome evaluation (+3) and "very likely" for belief strength (+3), this leads to a product of +9. This is done for each salient belief. The products are then summed to assess the overall valence (positivity vs. negativity) of the attitude, A_i. An example for one of the respondents is provided in Table 3-9. To avoid potential problem/confusion in terms of having, for example, -3x-3 provide the same product as +3x+3, outcome evaluation is re-coded on 1-7 scale by adding +4. In this case, a positive score means that, overall, the participant is in favour of increased borrowing. A negative score means that, overall, the respondent is against increased borrowing. The total attitude score is calculated as +137 reflecting a strong positive attitude in favour of increased borrowing. Because there are 7 items, the possible range of total score is (7x±3) = -147 to + 147[9].

Thus, for this particular person, while the belief about tax benefit is very negative, its influence is reduced by the other beliefs that are positive. This approach may imply that two DMs may have the same set of beliefs about long-term debt financing of business expansions but a totally different attitude because of different outcome evaluations or belief strengths. In this case, the DMs' attitudes, A_i, are influenced by either (i) the beliefs that are salient in a situation, (ii) the evaluations of beliefs, or (iii) the strength of belief (Ajzen and Fishbein, 1980). In this study, "higher" values of attitudes indicate a favourable attitude towards debt capital and hence high risk taking behaviour. Thus a positive relationship between intention to borrow and attitude is expected.

3.4.3.1.3 Subjective Norm Assessment

Subjective norm refers to a DM's belief that most of his or her important others think that she or he should or should not perform that behaviour. Subjective norm is a product of motivation to comply and normative belief. Normative beliefs are beliefs about what a specific referent[10] person thinks one should or should not do regarding the behaviour. In this survey, for each referent, we have a normative belief: what the respondents think that referent would want them to do. Table 3-10 depicts sample items used to elicit respondents' normative belief and motivation to comply. Thus, a DM's subjective norm is a function of their normative beliefs for salient referents, and motivation to comply with these different referents. The subjective norm score for the i-th individual, SN_i, is calculated as the sum of the products of motivation to comply and normative belief. Table 3-11 provides an example of the subjective norm score for a single DM. A positive score means that, overall, the participant experiences social pressure to increase debt. A negative score means that, overall, the respondent experiences social pressure not to increase debt. The possible range of total scores is -147 to +147. For the respondent in

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[9] The important aspect of this measurement scheme is that zero represents a neutral attitude, positive score represent attitudes in favour of the behaviour as described, and negative scores represent attitudes against the behaviour as described.

[10] A referent is a specific individual or group who may influence one's behaviour.

Table 3-11 the overall score is 24 suggesting that the subjective norm score of the respondent reflects fairly weak negative social pressure to increase debt.

For each referent, the normative belief and motivation to comply are multiplied. The product is then summed across all referents. Two DMs may have the same set of referents about behaviour but a totally different subjective norm because of different normative beliefs or motivations to comply. Thus, changing what referents are salient in a situation, or changing perceptions of normative beliefs, or changing motivation to comply can change a person's attitude.

3.4.3.1.4 Perceived Behavioural Control (PBC)

To obtain a measure of PBC each control belief is multiplied by the perceived power of a particular control factor to facilitate or inhibit performance of the behaviour, and the resulting products are summed across the n salient control beliefs to produce the perception of behavioural control. Sample questions for control belief and control power are given in Table 3-12. Table 3-13 provides an example of the perceived behavioural control score for a single DM. The perceived behavioural control score for the i-th individual, PBC_i, is calculated as the sum of the products of perceived power and control belief. Using this method, a positive score means that, overall, the respondent feels in control of increasing debt. A negative score means that, overall, the respondent does not feel in control of increasing debt. The possible range of the perceived behavioural control score is -273 to +273. For the respondent in Table 3-13 the overall score is -12 suggesting that the perceived behavioural control score of this respondent reflects a fairly weak negative control.

For each control factor, control belief and control power are multiplied. Then the product is summed across items. The above approach suggests that two DMs may have the same set of control factor but a totally different perceived behavioural control because of different control beliefs or control power. Thus, a person's attitude can be changed by changing what control factors are salient in a situation, or by changing perceptions of control beliefs, or by changing control power.

In addition to the EU and TpB approaches, two other approaches are used to elicit attitudes; a self-rating and evidence of previous gambling activities. The self-rating risk attitude is obtained based on responses to questions: "own willingness to undertake risky business propositions as compared to other executives or directors," "company's willingness to undertake risky business propositions as compared to other companies in the industry," and "ease or difficulty to accept taking debt financing risks."

In this study, the frequency of respondent's engagement in any 'gambling activities' over the last 12 months (e.g., buying lottery, recreational betting, casino, etc)[11] is used as a proxy for past behaviour/risk taking habit. It can be hypothesized that those people who frequently participate in such activities may tend to borrow more and hence one may expect a positive relationship between habit, attitude and intention (Rhodes and Courneya, 2003).

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[11] Due to the order of magnitude of the dollars at risk, it should be stated that there are differences in the scale of risk between a) the activities used as measures of past behaviour (i.e., buying lottery tickets, etc) and b) the nature of the intended behaviour (i.e., borrowing). Empirically, there are significant numbers of people who buy lottery tickets but also purchase insurance, as one example. Thus caution must be taken in extrapolating from risk-taking behaviour in small-scale gambling to risk-taking in borrowing large sums of money.

3.4.3.2 Fishbein's Multi-attribute Attitude Model

Fishbein's multi-attribute attitude model is an attitude measurement technique. The multi-attribute attitude model focuses on selected object attributes or beliefs to quantify attitudes using a scale (e.g., Likert Scale). The wide-ranging multi-attribute attitude elicitation method has been previously used to elicit general unobservable DMs' risk attitudes (Pennings and Garcia, 2001). A series of general questions (based on direct measures as opposed to belief based measures) are asked in order to gauge respondents' agreement with various questions related to debt financing (Table 3-14). To investigate DMs' attitude towards leveraging risk, descriptive statistics are calculated for each item. For a large sample size, statistical techniques such as confirmatory factor analysis or structural equation modeling or factor analysis can be used to create a composite attitude index.

3.4.4 Demographic and Other Exogenous Variables

To account for variations across individuals, demographic information is obtained: respondent's gender, age category, income category, responsibility (manager or director), awareness of various risk management practices, frequencies of previous risk taking behaviour, marital status, educational category and self rating of risk attitude. For example, MacCrimmon and Wehrung (1986) argue that risk aversion may increase with age. On the contrary, older individuals may take more risks because they can afford to do so. However, if older individuals are characterized with higher income, the result could be mixing together age and income effects. Empirically, the impact of the interaction between income and age can be modeled and the connection can be explored. Age information is gathered using a set of six categories. Information on income and education is gathered using a set of nine categories. A summary of respondents' demographic characteristics is given in section 3.6. These variables are used as explanatory variables in the TpB model.

3.5 Empirical Model

3.5.1 Fisher's Exact Test and Mann-Whitney Tests

To explore if there are differences in risk attitudes between managers and directors various statistical methods are applied (e.g., non-parametric test and regression analysis). First, Fisher's exact test (McKinney et al., 1989), and the Mann-Whitney test[12] are used to assess if there are any significant differences between the attitudes of managers and directors for each risk attitude construct (i.e., EU, TpB). Fisher's exact test is used to test if the risk attitudes obtained using the stochastic dominance approach is different between managers and directors. The Mann-Whitney test is applied to investigate if the risk attitudes obtained using the Fishbein's general risk attitudes assessment and the theory of planned behaviour differ systematically.

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[12] Non-parametric procedures are recommended when sample size is small or the distribution of the population from which the data is obtained is uncertain (Hollander and Wolfe, 1973).

3.5.2 Binary Probit Regression

Multiple regressions are applied to investigate the relationship between risk attitudes and exogenous variables (e.g., age, income, age, and education). Since the dependent variable from the stochastic dominance method is a discrete random variable (i.e., A or B; Table 3-2), the appropriate way to model factors explaining risk attitudes is to define the probability of RA=1, not the value of RA itself, as a function of the exogenous variables. Thus, a binary choice probability model that defines the probability of risk aversion as a function of the exogenous variables is proposed. The binary choice probability model is a regression (Greene, 2000):

$$E[RA \mid x] = 0[1 - F(x_i;\beta)] + 1[F(x_i;\beta)] = F(x_i;\beta) \qquad (3\text{-}10)$$

In empirical applications, the normal (probit model) and logistic (logit model) distributions have been commonly used to define the probability distribution. Based on the risk attitude information obtained using stochastic dominance approach, the following probit model is specified:

$$RA_i{*} = \eta_0 + \sum_{j=1}^{n} \eta_j x_i \; + \; \varepsilon_i \qquad (3\text{-}11)$$

where x's are explanatory variables (i.e., age, income, education and manager-director dummy);

$$RA_i = \begin{cases} 0 \text{ if } 0 > RA_i{*} & \text{(Less risk averse)} \\ 1 \text{ if } \mu_1 \le RA_i{*} & \text{(More risk averse)} \end{cases} \qquad (3\text{-}12)$$

where the probabilities are given as

$$F(x_i;\beta) = \begin{cases} \Phi\left(\eta_0 + \sum_{j=1}^{n} \eta_j x_i\right), & RA = 0 \\ 1 - \Phi\left(\eta_0 + \sum_{j=1}^{n} \eta_j x_i\right), & RA = 1 \end{cases} \qquad (3\text{-}13)$$

The estimation of the probit/logit model is based on a maximum likelihood method where each observation is viewed as a single draw from a Bernoulli distribution. For a sample of n observations, the log-likelihood function can be obtained as:

$$\log L = \sum_{i=1}^{n} \{RA_i \log F(x_i;\beta) + (1 - RA_i)\log[1 - F(x_i;\beta)]\} \qquad (3\text{-}14)$$

For the probit model (i.e., the normal distribution), the log-likelihood function is:

$$\log L = \sum_{RA=0} \log[1 - \Phi(x_i;\beta)] + \sum_{RA=1} \Phi(x_i;\beta) \qquad (3\text{-}15)$$

3.5.3 Multiple Regression and Ordered Probit Regression

Finally, for the data obtained based on the theory of planned behaviour, the following simultaneous system of equations is specified.

$$A_i = \alpha_0 + \sum_{j=1}^{n} \alpha_j x_{ji} \; + \; \varepsilon_{1i} \qquad (3\text{-}16)$$

$$SN_i = \delta_0 + \sum_{j=1}^{n} \delta_j x_{ji} \; + \; \varepsilon_{2i} \qquad (3\text{-}17)$$

$$PBC_i = \phi_0 + \sum_{j=1}^{n} \phi_j x_{ji} + \varepsilon_{3i} \tag{3-18}$$

$$BI_i = \beta_0 + \beta_1 A_i + \beta_2 SN_i + \beta_3 PBC_i + \sum_{j=1}^{n} \beta_j x_i + \varepsilon_{4i} \tag{3-19}$$

where A_i is attitude towards behaviour, SN_i is subjective norm, PBC_i is perceived behavioural control, x_{ji} are demographic characteristics for the i-th individual (j = age, manager-director dummy variable, age, income), β, α, δ and φ are parameters to be estimated and ε_i's are i.i.d disturbance terms. The above equations are estimated independently. Equations (3-16)-(3-18) are estimated using ordinary least squares. Maximum likelihood procedures are applied to estimate parameters of equation (3-19)

When the dependent variable takes on more than two values, but these values have a natural ordering, the ordered probit model is often appropriate (McKelvey and Zavoina, 1975). Since the dependent variable for behavioural intention is an ordinal response, ordinary least squares may not be appropriate. Thus, an ordered probit model is proposed to estimate the equation for behavioural intention.

Ordered-response models recognize the indexed nature of various response variables. Underlying the indexing in such models is a latent but continuous descriptor of the response. In an ordered probit model, the random error associated with this continuous descriptor is assumed to follow a normal distribution. The observed and coded discrete behavioural intention to increase or decrease debt capital variable, BI, is determined from the model as follows:

$$BI_i^* = \beta_0 + \beta_1 ATB_i + \beta_2 SN_i + \beta_3 PBC_i + \sum_{j=1}^{n} \beta_j x_{ji} + \varepsilon_{4i} \tag{3-20}$$

where BI_i^* is a latent and continuous measure of behavioural intention for the i-th DM and J is an index of possible values for BI_i. The relationship between BI_i^* and BI_i is defined in terms of threshold parameters (μ's) to be estimated with β; that is, $BI_i = 1$, if $\mu_0 < BI_i^* \leq \mu_1$; $BI_i = 2$, if $\mu_1 < BI_i^* \leq \mu_2, \ldots$, $BI_i = J$, if $BI_i^* > \mu_{j-1}$. In the above, the respondents have their own intensity of behavioural intention. The intensity of behavioural intention depends on observed exogenous variables, and unobservable factors, ε_{4i} . The ordered probit model is based on an assumption that respondents could respond to the question with their own BI_i^* if asked to do so. Given only seven or five possible discrete answers (depending on the question), respondents opt for the choice that most closely represents their own intentions on the question (Greene, 2000). However, one of the undesirable consequences of applying linear regression is that "it implicitly assumes that respondents who give the same response have exactly the same attitude" (Daykin and Moffatt, 2002). This may not be the case as a particular response may be consistent with a range of attitudes and ignoring such differences may lead to biased estimates. The ordered probit model accommodates such differences. With the assumption that ε_{4i} is distributed normally across sample observations, the probability that BI_i falls into the j-th category is given by:

$$\text{Prob}(BI = j) = \Phi(\mu_j - \beta' x) - \Phi(\mu_{j+1} - \beta' x) \tag{3-21}$$

where Φ denotes the cumulative standard normal distribution function and μ_j and μ_{j+1} denote the upper and lower threshold values, respectively, for the j-th category. If j is the lower category, then the lower threshold value is -∞ and the upper threshold value is zero. If j is the higher category, the upper threshold value is $+\infty$. For all probabilities to be positive, the ordering $0 < \mu_1 < \mu_2 < ... < \mu_{J-1}$ must hold. The estimated coefficients from an ordered probit regression do not have an intuitive interpretation. As a result marginal effects are calculated to provide more information. For the above probabilities, the marginal effect of changes in the regressors for the j-th category is:

$$\frac{\partial \Pr ob(BI = j)}{\partial x} = \left[\phi(\mu_j - \beta' x) - \phi(\mu_{j-1} - \beta' x)\right] \tag{3-22}$$

where ϕ is the standard normal density function. Note that the marginal effects sum to zero (Greene 2000). The marginal effect for binary explanatory variables is estimated as the difference between $\Pr ob(BI = j) | x = 1$ and $\Pr ob(BI = j) | x = 0$.

3.6 Results and Discussion

3.6.1 Sample Characteristics

A total of 139 survey questionnaires were sent to managers and directors of the 17 co-operatives. Of these, 30 completed questionnaires were returned for a response rate of 22 per cent[13]. Table 3-15 shows sample respondents' characteristics. The respondents included 2 females and 28 males. Fourteen of the respondents were managers and the other sixteen were directors. Approximately 67 per cent of the respondents had more than high school education, 30 per cent of the respondents were above the age of 54 years, and 50 per cent of the respondents had before tax household income greater than CAN$100,000 for the year 2003. More than 80 per cent of the respondents were from agribusiness supply co-operatives while the rest of the respondents were from feed mill, fruit and flower co-operatives (Table 3-16).

More than 63 per cent of sample respondents indicated that they would 'possibly' approve a 100 per cent increase in additional borrowing for the purpose of the proposed expansion. When the sample respondents were asked to provide the 'appropriate' proportion of additional borrowing for the business expansion, 27 per cent of the respondents recommended 75 per cent long-term debt to finance the proposed business expansion. In terms of co-operative DMs' structure, 50 per cent of the managers and 38 per cent of the directors would like to approve 25 per cent long-term borrowing for the proposed business expansion. The above descriptive results may indicate that there are differences in terms of financial risk attitudes among co-operative DMs in general, and managers and directors, in particular.

3.6.2 Manager-Director Differences in Attitudes

In this section, tests for differing attitudes towards (i) risky investments; (ii) increased long-term borrowing; (iii) lotteries; and (iv) general business situations between directors and managers, are conducted using t-tests and Mann-Whitney tests. The results from these methods are presented independently below; and then summarized.

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[13] It should be noted that the overall response rate in this study is much lower if non-responses to the initial contacts regarding participation are considered.

3.6.2.1 Differing Attitudes Towards Risky Business Investment

As discussed previously, two stochastic dominance (SD) scenarios are presented to survey respondents (Table 3-2). In Scenario I, alternative A dominates alternative B by FSD; that is, alternative A is a rational choice for any individual who prefers more to less. Of the 30 sample managers and directors only 3 selected alternative B; 2 of 14 managers and 1 of 16 directors. From these results, it can be concluded that the behaviour of a majority of the sample DMs conforms to the monotonicity axiom.

Scenario II is important for testing differing risk-aversion or risk attitudes of managers and directors. In the second scenario, B dominates A by SSD. Any risk-averse individual should prefer B to A. The survey results indicated that only 10 out of the 30 respondents selected alternative B; 2 out of the 14 managers and 8 out of the 16 directors. Combining the results for the two scenarios, it can be inferred that i) 90 per cent of the DMs (i.e, managers and directors) selected an alternative that is consistent with FSD (i.e., $U'(w)>0$) and ii) only 33 per cent of the DMs selected an alternative that is consistent with risk averse behaviour (i.e., alternative B). Thus, the majority of the respondents (67 per cent) do not appear to be risk-averse.

The main objective of this study is to explore if there are any divergences in risk attitudes between managers and directors of co-operative businesses. From the survey results managers appear to be less risk averse than their peers. A question may be asked: *"do the risk attitudes of DMs correspond to whether or not they are directors or managers?"* Alternatively, do managers and directors show the same risk propensity? To answer this question, Fisher's exact test[14] is conducted using survey responses. For Fisher's exact test, the estimated one-tail p-value is equal to 0.045, suggesting that directors and managers have different risk attitudes. Table 3-17 summarizes Fisher's exact test of DMs' risk attitude divergence.

3.6.2.2 Willingness to Pay for Lottery

One of the problems with the WTP risk attitude elicitation procedure relates to non-response; that is, a lack of response to a question asking for a certainty equivalent value. The non-response could be due to a religion or ideology that considers gambling to be morally objectionable (Hartog et al., 2000), or it could be due to a high degree of risk aversion. In the present 2 respondents did not answer the WTP question. In the case of this study and survey, it cannot be determined what contributed to non-response. However, non-response is assumed to reflect strong risk aversion.

Table 3-18 summarizes the willingness to pay, provided by respondents, for lotteries with specific payoffs and probabilities of winning. The results indicate that the willingness to pay for a lottery ticket may increase with either the probability of winning or the magnitude of the prize. On average, sample co-operative DMs are willing to pay less than the expected value of the lottery prizes. This may be indicative of the fact that risk aversion tended to be the most frequent situation for the sample respondents. Among the respondents directors tend to be willing to pay relatively more for lottery tickets than are managers. Table 3-19 characterizes the risk attitudes of respondents based on the

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[14] Fisher's exact test is a non-parametric statistical test used to determine if there is nonrandom association between two categorical variables (risk-averse –non-risk averse, managers –directors). This test uses frequency data to detect group differences.

WTP procedure. Frequency distribution results provide an indication that the majority of respondents may exhibit risk averse behaviour. In general, an examination of the mean absolute risk aversion measure ($\overline{\rho}$) provides an indication that managers are more risk averse than directors. In particular, managers potentially tend to be more risk averse than directors for low and high magnitude lotteries. Risk aversion tends to decline with increased probability of winning the lottery prize and the increased magnitude of the prize (Table 3-19).

Finally, to test for the reliability/robustness of the measure of ρ, a nonparametric Kendall's τ_b rank correlation is calculated for the different lottery specifications (Table 3-20). The correlations between lotteries are found to be statistically significant at the 95 per cent confidence level.

3.6.2.3 Attitudes towards Long Term Borrowing

A test for potential differences in attitude towards long-term borrowing between managers and directors of agribusiness co-operatives is also conducted based on information gathered using TpB procedures. For each individual, the index for attitudes towards long-term borrowing is constructed as in Table 3-9. Both a t-test and a Mann-Whitney test are then applied to assess if there are any potential differences in attitudes between sample managers and directors (Table 3-21).

Results from both tests suggest that there are statistically significant mean differences between sample managers and directors in terms of attitudes towards increased borrowing. This may indicate that directors tend to have more favourable attitudes towards a higher debt to equity ratio. Given the low response rate, the results from this study suggest the potential importance of differences in attitudes between managers and directors in determining the capital structure and a need for further study.

Evidence for co-operatives in Portugal indicated that managers generally tend to adopt management practices that reduce debt to equity ratios while members do the opposite (Rebelo et al., 2003). In the U.S., Kerkel et al (2003) have also found that managers and board members differ significantly in their attitudes towards value-added activities and new generation co-operatives on several issues. The principal agent theory also suggests that managers prefer moderate or low levels of corporate debt as it is in their interest to reduce the chances of company bankruptcy (Firth, 1995).

The existence of divergences in attitudes based on the TpB approach is consistent with the findings from the SSD analyses, although the qualitative implication of the divergence is different. The divergence in attitudes may have implications for the performance of the firm in terms of agency problems. Demsetz and Lehn (1985) and Jensen and Meckling (1976) state that if managers' holdings are substantial, their motivations become aligned with those of shareholders and the agency problem is reduced. In the case of a co-operative business, where managers have no equity holdings in the business, the motivations of managers and directors may not be very well aligned. Thus, differences in risk attitudes may be expected. In this study although the sample size is insufficient to draw strong conclusions, the results are consistent with previous findings.

3.6.2.4 General Attitudes towards Business Risks

Table 3-22 provides mean values and a summary of Mann-Whitney test results for general attitude differences between managers and directors. The mean comparisons indicate that of the 12 issues examined there are four for which the risk attitudes of managers differ from those of co-operative directors. Sample directors are more likely to be "risk neutral" when it comes to financing than are managers. Sample managers tend to disagree with increases in debt financing, due to the likely increase in investment risks. While sample directors are neutral, sample managers tend to agree that keeping the company's money safe is more important than earning higher returns with risk. On the other hand, sample managers are more likely to be "less risk averse" in trying out new ideas than are co-operative directors. However, once again strong conclusions cannot be made due to the small sample size.

3.6.2.5 Summary of Differing Attitudes Tests

The above results suggest that sample managers and directors potentially differ in their (risk) attitudes. As well, there appears to be inconsistencies across measurement methods. Directors are less inclined to engage in risk-seeking behaviour as measured by stochastic dominance, and are more inclined to exhibit risk-taking behaviour as measured by the TpB and WTP approaches. Given these differences, and the lack of a sufficiently large sample to be representative, this is an avenue for further research.

Previous studies indicated that empirical findings differ across methods used (Schoemaker and Hershey, 1992; Kirchler et al., 2001; MacCrimmon and Weherug, 1986; Laughhunn et al., 1980; Schoemaker, 1993). Yet, the principal-agent theory assumes that the agent (i.e., manager) is risk averse (Basu et al., 1985; Laffont and Martimort, 2002) or at least no more of a risk-taker than the principal (i.e., members and directors) (Coughlan and Sen, 1989). In the case of directors for co-operatives, risk behaviour is ambiguous. Based on the principal agent theory, as owner of the co-operative it can be the case that directors (principal) are risk neutral or risk takers or less risk averse as opposed to managers. On the other hand, as the leader/DM of the co-operative (serving as an agent to the member), it can be claimed that they are more risk averse or less of a risk taker as compared to members. Thus, in the co-operative business, the directors as 'an agent and member' are presumed to be more risk averse than the members of the co-operative and so may be inclined to resist more risky business alternative.

A decision-making process that integrates and reflects each DM's (risk) preference may potentially enhance the chance of successfully achieving the overall goals of the co-operative business. By assessing and comparing risk preference differences between directors and managers, a co-operative business may be able to harmonize managers' intentions with those of the directors to the advantage of its member-patrons.

3.6.3 Determinants of Risk Attitudes

3.6.3.1 Determinants of Risk Attitudes towards Risky Investment

In the previous section sample co-operative managers and directors appeared to differ in their attitudes towards risky investments. As opposed to directors, managers tend to be less risk averse when faced with a choice between two alternative risky business scenarios. In this section, the potential impact of individual characteristics on risk attitudes towards a risky investment is examined. The measurement of the dependent variable is based on the response for the SSD question, which is a binary variable: 'less risk averse' and 'more risk averse.' As a result, a probit model is implemented. The explanatory variables in this model include respondents' age, income, education and manager-director variables. All of the explanatory variables are dummy variables. Due to multicollinearity and micronumerosity (Gujarati, 1995) problems between the age dummy and the manager-director dummy variables, three different models are estimated: a model with both age and manager-director dummies (Model A), a model without the age dummy (Model B) and a model without the manager-director dummy (Model C). Parameter estimates of these models are summarized in Table 3-23. The explanatory variables explain approximately 37 per cent of the variation in the probability of risk aversion. In addition, the probability of correct prediction for this model is approximately 77 per cent.

For the model that includes both age and manager-director dummy variables (Model A) the coefficient of age is statistically significant and positive. This may suggest that for sample co-operative DMs over the age of 54 years old, the probability of being 'more risk averse' is higher. The coefficient for education is negative and statistically significant at the 10 per cent significance levels, suggesting that higher level of education may be negatively correlated with the probability of being 'more risk averse.' Put differently, those respondents with an education level above high school tend to be 'less risk averse.' When the age variable is dropped from the probit model, the manager-director dummy variable is found to have a statistically significant effect on the probability of being 'more risk averse. ' As opposed to directors, sample managers may be less risk averse when considering risky business investments.

3.6.3.2 Determinants of Attitudes Towards Long Term Borrowing

Factors that influence DMs' attitudes towards long-term borrowing and their behavioural intention to borrow more in order to finance business expansion are also examined in this analysis. *Are DMs' attitudes towards long-term borrowing and their behavioural intentions to approve additional borrowing related to their personal characteristics and social psychological factors?* Factors hypothesised to have an effect on attitude, subjective norm and perceived behavioural control are investigated using multiple regressions. Furthermore, the impacts of attitude, subjective norm, perceived behavioural control, frequencies of previous gambling behaviour, and individual characteristics on behavioural intentions are explored using ordered probit model estimation. The parameter estimates for equations (3-16)-(3-18) (i.e., attitude equation, subjective norm equation and perceived behavioural control equation, respectively) are obtained using ordinary least-square procedures in TSP 4.5.

The goodness of fit (i.e., R^2) ranges between 0.176 and 0.372 for the three models (Table 3-24). Being a manager may have a negative impact on the values (indices) of attitude, subjective norm and perceived behavioural control. As opposed to directors, sample managers appear to look less favourably on increases in long-term borrowing to finance business expansion. Age has a statistically significant relationship with attitude, subjective norm and perceived behavioural control. Accordingly, sample DMs who are older than 54 years of age may also have unfavourable feelings towards increased long-term borrowing. Again, due to the limited sample size the above evidence may not be sufficient to permit definite conclusions on the effect of the exogenous variables on the probability of risk aversion.

3.6.3.3 Determinants of Behavioural Intention

The next step is to investigate the impacts of social psychological variables (i.e., attitude, subjective norm and perceived behavioural control) and respondents' characteristics on behavioural intention to increase long-term borrowing. The parameter estimates for equation (3-19) (i.e., behavioural intention equation) are obtained using a maximum likelihood procedure in TSP 4.5. In this study, 53.3 per cent of the sample respondents reported that they intend to approve additional long-term borrowing over the next two years, of whom 13.3 per cent were "very likely" to approve borrowing. On the other hand, whereas 10 per cent of the respondents never intend to approve 100 per cent equity financing, 90 per cent of the respondents reported that they "would endorse" 100 per cent equity financing, of whom 50 per cent of the respondents reported that they would approve 100 per cent equity financing "most of the time," 6.7 per cent of the respondents would approve 100 per cent equity financing "always" and 9 per cent of the respondents stated "often".

The behavioural intention variables are based on the responses to three survey questions: willingness to approve additional borrowing (Model I); tax-benefits of debt and intention to borrowing (Model II[15]); and intention to finance through equity only (Model III). Maximum likelihood estimates for the parameters of the ordered probit model are given in Table 3-25. The estimated threshold (cut-off) parameters have the expected ordering. Positive estimates for the coefficients of social psychological variable and individual characteristics may suggest that the likelihood of intention to approve additional borrowing increases (decreases) with higher values for Model I and II (Model III) (Table 3-25). Results for the three models are summarized and compared below.

For Model I, attitude, perceived behavioural control and frequency of previous gambling behaviour have a statistically significant relationship with behavioural intentions. The above results may indicate that the probability of approving additional borrowing increases with increases in the value of attitudes. In the same vein, the probability of approving additional borrowing increases with increased frequency of previous gambling behaviour. The probability of approving additional borrowing, however, may decrease with increases in the value of perceived behavioural control. The individual characteristics do not have a statistically significant impact on behavioural intention for model I.

For Model II, attitude, subjective norm, age and income level have a statistically significant association with behavioural intentions to approve additional borrowing. In terms of marginal effects, an "increase" in favourable attitude towards long-term borrowing may increase the probability of approving additional borrowing for business expansion. Conversely, all other things being equal, an increase in the value of subjective norm may result in a decreased probability of approving additional borrowing for business expansion. This may suggest that individuals with higher social pressure from referents are less likely to approve additional borrowing for business expansion. Age and income have statistically significant negative effects on the probability of approving additional borrowing. Older sample respondents are less likely to approve additional borrowing for business expansion. Higher income category respondents are also less likely to approve, which may be because of the positive correlation between age and income for the sample respondents.

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[15] Model II is used to explore the potential impact of additional information on DMs' behavioural intention to approve additional borrowing.

For Model III, attitude, subjective norm and frequency of previous gambling behaviour have a statistically significant influence on intention to finance solely through equity capital. As expected, the sign of the coefficients for Model III are opposite to those for Model I and Model II. An increase in favourable attitude towards long-term borrowing and the frequency of previous gambling behaviour decreases the probability of financing through the use of 100 per cent equity capital. Subjective norm is found to have a positive influence on the probability of financing the business expansion via 100 per cent equity. As stated previously no strong conclusions can be drawn regarding the effects of exogenous variable on the probability of intention to approve additional borrowing due to the limited sample size.

3.6.4 Familiarity with Risk Management Strategies

3.6.4.1 Benefits of Risk Management

Risk management is an important activity undertaken by financial and non-financial firms in order to mitigate the impact of uncertainties on the value of the firm (Mian, 1996). Risk management is a process of trying to influence the effect of risk exposure on firm value. For example, from a practical point of view, hedging may be a value-increasing strategy for the firm when markets are imperfect. Risk management is desirable because it lowers contracting/agency costs (Campbell and Kracaw, 1987; Mayers and Smith, 1987; Bessembinder, 1991), financial distress costs (Mayers and Smith, 1982; Smith and Stulz, 1985), taxes (Smith and Stulz, 1985), and external financing costs associated with capital market imperfections (Froot et al., 1993; Mian, 1996).

While these motives for undertaking risk management are based on maximization of the firm's value, an alternative motivation for risk management is based on managerial utility maximization. When a manager's expected utility depends on the distribution of future firm value, the use of risk management strategies may be explained by managerial risk attitudes (Stulz, 1996; Tufano, 1996). Managers tend to reduce risks by hedging when their expected utility is a concave function of future firm value, if their future wealth is a linear function of firm value.

On the contrary, managers tend to be risk-taking if their future wealth is a convex function of firm value since a larger volatility of firm value increases their personal wealth. Thus, if the manager owns a significant portion of the firm, it can be expected that the firm will hedge more of its risk exposures. To a certain extent this depends on the managerial incentive contract and performance measures. In the case of the co-operative business if the managerial incentive contract is not a linear function of the firm's value, one may expect that the firm is less likely to hedge. Further to this analysis, if the managers of the co-operative business are less likely to be involved in risk management activities, their knowledge about alternative risk management strategies may be limited. Results from the survey on risk management knowledge of managers and board of directors of co-operative firms are presented below.

3.6.4.2 Risk Management Strategies Knowledge

Respondents indicated their level of familiarity with risk management strategies on a scale of -3 (low) to +3 (high). Mean values for managers and directors are presented in Table 3-26. Sample managers and directors appear to be most knowledgeable about insurance, leasing/renting, and investment diversification and least knowledgeable about the use of derivatives as a risk management strategy. The majority of co-operative DMs seem to be familiar or very familiar with insurance (85 per cent), leasing/renting (94 per cent), deferred or delayed price contract (56 per cent) and investment diversification (77 per cent). Conversely, less than 20 per cent of co-operative DMs were familiar or very familiar with derivatives (16 per cent), currency swaps (17 per cent), interest rate swaps (20 per cent) and commodity swaps (13 per cent) as risk management tools.

Comparisons between sample managers and directors indicate that, with the exception of deferred or delayed price contract, there are no statistically significant differences in terms of familiarity with the various risk management strategies (Table 3-26). The absence of share ownership by the firm manager in co-operative firms may provide the incentive to expend less effort to learn more about different types of risk management strategies than had the manager been the sole owner of the firm. In some cases, the future wealth of managers of co-operative firms may not be a linear function of firm value which gives less incentive to closely learn more about alternative risk management strategies. Because the board of directors, too, have limited ownership shares in these companies, they may also have little incentive to look for alternative risk management strategies.

3.6.5 Importance of Risk Factors and Effectiveness of Risk Management

Respondents were asked to rate, on a scale of 1 (low) to 7 (high), a number of sources of risk in terms of the importance to their company. Mean values for sample managers, directors, and pooled responses are provided in Table 3-27. Weather risk was rated as the top ranking source of income variability (5.76), followed by credit risk (5.690) and market place competitiveness risk (5.22). Foreign exchange risk was the lowest rated source of risk (2.80). Debt leveraging risk was rated 10th most important overall, in terms of mean response (Table 3-27). With the exception of credit risk, there were no statistically significance differences in terms of the ratings of risk factors between managers and directors.

Respondents were also asked to rate the degree to which these risks are effectively managed by their companies on a scale of 1 (low) to 7 (high). Mean values for the importance of rating of risk factors are provided in Table 3-27. Sample managers and directors think that property damages/losses and debt leverage risks are relatively well managed in their companies. There were no significant differences between managers and directors in terms of ranking effectiveness of risk management (Table 3-28) with the exception of effectiveness of weather risk management. As opposed to managers, sample directors thought that weather risks were well managed.

3.6.6 Impact of Risk Attitudes on Co-operative Plant Automation Decision

From a co-operative business decision makers' point of view, knowledge of the relationship between financing decisions, profitability and financial risk is critical in order to avoid financial distress and to ensure long-term growth of the sector. As well, an improved understanding of the impact of differences in risk preferences of managers and directors and differences in their relative decision making power on the choice of capital structure is equally important.

Previous studies have investigated the impact of directors' and/or managerial diversity on firm performance. Others have explored the influence of heterogeneity on financial performance. Previous empirical evidence suggests that the impact of heterogeneity upon firm performance is mixed. For example, some studies have shown that group diversity leads to better strategic decision-making (Bantel, 1993; Simons and Pelled, 1999). Others have found no relationship (Elron, 1996), while some literature on group diversity suggests that homogeneous decision-making groups perform better than diverse ones (Maznevski, 1994; Hambrick et al., 1996; Knight et al., 1999). Although it appears that there is equivocal evidence about the effects of diversity on group performance (Erhardt et al., 2003), there are no empirical studies exploring the relationship between differing risk attitudes on firm performance.

This section briefly demonstrates the possible effects of differences in risk attitudes between managers and directors on the choice of capital structure, profitability and risk exposure of co-operative agribusiness firms. To illustrate the impact of divergence in risk attitudes and decision making power on firm performance a real co-operative with hypothetical DMs is "made up." This co-operative is assumed to automate its plants using long term debt. The proportion of debt in financing the plant automation is assumed to be a function of risk attitudes. The following analysis is conducted for the purpose of illustrating the importance of considering differing risk attitudes on firm performance. No policy conclusions can be drawn regarding the effects of differing risk attitudes on firm performance based on this illustration.

Important decision variables that may be affected by plant automation include: sales (output), purchases of raw material, gross investment, plant automation and upgrading, and patronage payments. These choice variables are expected to be affected by firms' debt to equity mix and the structure of debt (short and long term debt). However, the analysis in this study focuses on the impact of long-term debt only.

The goal of the deterministic dynamic simulation model (DDSM) is to be able to illustrate the impact of the degree of risk aversion and decision making power on firm's capital investment financing decision and performance. This goal is accomplished by using historical financial information for a case co-operative over 15 years. The DDSM is composed of financial statements (i.e., income statement, balance sheet and cash flow statement), the analytical hierarchy process for modeling group decision making, risk aversion parameters and a summary of financial ratios and welfare measures. The risk modeling section contains entries on the degrees of risk aversion and divergence in decision making power. This section uses the AHP (discussed below) to come up with a single measure of group degree of risk aversion. The AHP section is placed on a separate spreadsheet and linked to the financial statement section through its impact on debt to equity ratio. Debt financing is assumed to influence the level of additional investment in capacity or automation depending on the weighted degree of group risk aversion. Note that additional investment can be financed by debt or equity. However, the proportion of debt and equity depends on the degree of the weighted group risk aversion, among other things. In turn, the production capacity of the co-operative business is assumed to be influenced by additional investment in plant automation.

3.6.6.1 Capital Expenditure and Members' Welfare

The key to understanding the impact of capital investment using debt financing is the determination of the desired level of capital stock. A co-operative that maximizes the present value of its members' welfare stream (or the stream of value added) would solve the following optimization problem:

$$\mathrm{MW} = \int_0^{\infty} e^{-rt}\left(Py - \int_0^{x^{i}} w(x)dx^{j} - w^{i}x^{i} - w_{k}I\right)dt \qquad (3\text{-}23)$$

subject to

$$y = f(x^{i}, x^{j}, K) \text{ and } K_{t+1} = I_{t} - \delta K_{t} \qquad (3\text{-}24)$$

where MW is the members' welfare, r is the interest rate, t is the time, e is the exponential constant, δ is the depreciation rate, P is the price of the co-operative's output, $y = f(x^{i}, x^{j}, K)$ is the quantity of the co-operative's output, w^{j} is the price of the raw materials purchased from the members of the co-operative, x^{j} is the quantity of the raw material purchased from the members of the co-operative, w^{i} is a vector of prices of other variable inputs, x^{i} is a vector of quantities of other variable inputs, w_k is the unit price for capital and I is capital investment. The integral $\int_0^{x^{j}} w(x)dx^{j}$ can be interpreted as the variable costs of producing x_j. In steady state, the solution to the above problem is: $\mathrm{MW} = f(p, w, k)$

$$\mathrm{MRP}_{k} = P\frac{\partial y}{\partial K} = w_{k} = p_{k}(r + \delta) = \mathrm{MC}_{K} \qquad (3\text{-}25)$$

where MRP_k is the marginal revenue product of capital, MC_k is the user cost of capital. In this context, any increase in the relative price of one unit of capital with respect to production, p_k, the depreciation rate, δ, and/or the interest rate, r, tends to increase the user cost of capital, MC_k, and thus reduce the demand for capital. This is called the cost of capital model (without tax expenses) (Jorgensen and Siebert, 1968) which states that factors of production are employed until the point where their marginal value product equals their marginal cost. Now, if $\mathrm{MRP}_k > \mathrm{MC}_k$, then business expansion, automation or upgrading via acquiring additional unit of capital increases profit or the contribution of additional unit of capital to revenue exceeds its contribution to costs.

On the other hand, if $\mathrm{MRP}_k < \mathrm{MC}_k$, acquiring additional capital for business expansion or automation or upgrading leads to a decline in profit resulting in financial distress. The change in interest rate would increase the rental price of capital. In this situation, economic theory suggests that firms should react to cost increases by using less capital in production. Thus, debt financed capital expenditures targeted at boosting co-operative firm's profitability (or members' welfare) and growth through economies of size may result in negative returns and hence increase risk of financial distress. If financial distress happens, co-operative companies may announce downsizing or closing of their businesses. The other downside to excessive borrowing is the fact that bankers do not like to lend to unhealthy businesses where loan repayment is not assured, suggesting that further financing may be a problem, and if possible at higher costs of borrowing.

3.6.6.2 Differing Risk Attitudes and Decision Makers Power

3.6.6.2.1 Risk Attitudes and Capital Structure

According to the cognitive literature, differing attitude refers to *variability concerning relatively unobservable ... attitudes ...* (Kilduff et al., 2000). In previous empirical studies the impact of differing risk attitudes on group decision-making has not been investigated. The relationship between differences in the DMs' attitudes and firm performance remains unclear, particularly because most studies focus on direct measurable attributes of individuals (Pfeffer, 1983) such as age, gender, education, etc., and tend to neglect the impact of differing attitudes on firm performance (Kilduff et al., 2000). One can ask: "*how does the difference in risk attitudes affect capital structure? What are the effects of divergence in attitudes on firm performance?*" These questions are explored by simulating the decision making process of managers and directors in a single firm industry situation. In this study, to illustrate the relationship between the DM's risk attitudes and the firm's optimal capital structure, a method proposed by Nelson and Escalante (2004) is adopted. Based on their approach, for a single decision maker, a firm's optimal debt level (D) is given by the following expression:

$$D = E\frac{(i-\mu_{ROA})(\mu_{ROA}+1)+\lambda\sigma^2_{ROA}}{(i-\mu_{ROA})^2-\lambda\sigma^2_{ROA}} \tag{3-26}$$

where D is the optimal level of debt, E is the level of initial equity, i is the known interest rate on debt, μ_{ROA} is the mean rate of return on assets, σ_{ROA} is standard deviation of return on assets, and λ is the coefficient of relative risk aversion. Taking into account the condition that causes the debt level to be positive and decreasing in λ gives the following bounds, which provide a reasonable range of the degrees of relative risk aversion, for the value of λ (Nelson and Escalante, 2004):

$$\frac{(\mu_{ROA}-i)^2}{\sigma^2_{ROA}} < \lambda < \frac{(\mu_{ROA}-i)(\mu_{ROA}+1)}{\sigma^2_{ROA}} \tag{3-27}$$

3.6.6.2.2 Firm Level Data and Models

To illustrate the potential influence of differences the DMs' risk attitudes and decision-making power on the financial performance of a co-operative, fifteen years of annual financial data for the period 1990-2003 are obtained from Lilydale Foods annual reports. In determining how the divergence in risk attitudes and decision-making power might have affected firm performance, the Sharpe Ratio (SR), co-operative profits (patronage payment), and producer surplus are used. The relationships between the balance sheet, income statement, and cash flow statement are established based on accounting principles. Among others, the following relationships and identities are used:

$$A_t = L_t + E_t \tag{3-28}$$

$$K_t = K_{t-1} + I_t \tag{3-29}$$

$$I_t = R_t + D_t \tag{3-30}$$

$$TR_t = Q_t{*}P_t \tag{3-31}$$

$$RC_t = X_t{*}W_t \tag{3-32}$$

$$\pi_t = TR_t - RC_t - LC_t - OC_t - IE_t - OE_t \tag{3-33}$$

$$PM_t = \frac{PR_t * r}{\left[1 - \frac{1}{(1+r)^{nT}}\right]} \quad (3\text{-}34)$$

$$r = \frac{i}{n} \quad (3\text{-}35)$$

Interest payment = r x Remaining principal

Payment against principal = Total payment - Interest payment

$$Q_t = \alpha_Q + \beta_Q K_t + e$$

$$X_t = \alpha_X + \beta_X Q_t + e \quad (3\text{-}36)$$

where t is a time index subscript, A_t is the level of assets; L_t is the level of liabilities; E_t is the level of equity; K_t is the level of capacity; I_t is the level of investment at time t; R_t is the level of retained earnings; D_t is the level of long term debt; TR_t is the level of total revenue; Q_t is the quantity of output produced and sold; P_t is the price of Q_t at time t; RC_t is the cost of raw materials, X_t, purchased from member farmers at price W_t; π_t is the profit of the co-operative; LC_t is the cost of labour ; OC_t is the operating costs, IE_t is interest expense; OE_t are other expenses; PM_t is principal payment; PR_t is the principal payment remaining at the beginning of time t; r is the interest rate per period; i is the annual interest rate; n is the number of periods per year; T is the total number of years; α_Q, α_X, β_Q, and β_X are parameters to be estimated.

3.6.6.2.3 Impacts of Automation on Members' Welfare

Automation is expected to shift the processor's supply curve by reducing the cost of production. Figure 3-6 shows the effects of plant automation on processor's output. The intersection of the output supply (S_0) and demand (D) curves results in the equilibrium price (P_0) and quantity (Q_0) under the old technology regime. Since the new technology following plant automation is more efficient and is expected to provide more output with the same amount of inputs or raw materials, the supply curve shifts to the right (denoted by S_1). The equilibrium price and quantity with the new technology are P_1 and Q_1. It is assumed that processors automate their plants if the per unit cost saving is greater than the price differential between the pre- and post-automation situations.

To calculate the resulting change in the members' welfare in response to automation-induced change in processors' output quantity, the pre-automation and post-automation producer surpluses and processor's profits are calculated based on the following simplifying assumptions: (i) automation results in a parallel shift in the processor's output supply curve; and (ii) the processor's output quantity shift may be translated into a per unit cost saving/reduction from labour use and other production costs defined as: $MC_t = \frac{\Delta Q_t}{Q_{0t}} \frac{P_{0t}}{e_s}$ where MC_t is a per unit cost savings; $\frac{\Delta Q_t}{Q_{0t}}$ is the expected percentage change in the quantity of the processor's output P_{0t} is the equilibrium price without automation; e_s is the processor's output supply elasticity. Multiplying this per unit cost savings by the quantity of output produced provides a measure of change in profits.

The processor's new output price on the retail market demand curve can be defined as:

$P_{1t} = \frac{P_{0t}\Delta Q}{Q_{0t}\,\epsilon_D} + P_{0t}$, where $\frac{P_{0t}\Delta Q}{Q_{0t}\,\epsilon_D}$ signifies the reduction in the price of output due to increase in the supply of the co-operative's output following automation; ϵ_D is the retail demand elasticity of the co-operative 's output (i.e., poultry processing in this example). It can also be assumed that as a result of economies of scale accompanying the automation, the co-operative processor's demand for farm output (i.e., live birds) may increase resulting in a (assumed) parallel shift in birds' demand curve. Figure 3-7 presents the effects of processor level plant automation on raw materials demand.

The intersection between the farmers' output supply (S_0) and processor's raw material demand (D) curves results in the equilibrium price (w_0) and quantity (X_0) under the old technology regime. Since the new technology is more efficient, the raw material demand curve shifts to the right (denoted by D_1). The equilibrium price and quantity with the new technology are w_1 and X_1. It is assumed that processors buy more raw materials if the per unit cost increase is less than the per unit effective output price differential between the pre- and post-automation situations.

This shift in the demand for birds may result in an increase in both the price and quantity of birds. Other things being equal, the new price for birds may be given as: $w_{1t} = \frac{w_{0t}\Delta X}{X_{0t}\,\epsilon_S} + w_{0t}$, where $\frac{w_{0t}\Delta X}{X_{0t}\,\epsilon_S}$ is the per unit increase in the price of birds; and ϵ_S is the farmers' output supply elasticity. The other effect of the increase in the demand for birds is that the shift in the processor's demand will ultimately result in a per unit increase in the cost of birds. A per unit cost increase due to the increase in the demand for birds can be given as: $w_{1t} = \frac{w_{0t}\Delta X}{X_{0t}\eta_D} + w_{0t}$, where η_D is the processor's raw material price elasticity of demand; and $\frac{w_{0t}\Delta X}{X_{0t}\eta_D}$ (=AC_t) is a per unit cost increase. Multiplying the per unit cost increase by the quantities of live birds purchased provides a measure of the change in the costs of production. Heuristically, the change in the co-operative processor's profits (surplus) may be defined as:

$$\Delta\Pi_t = (MC_t - AC_t + P_{1t} - P_{0t})[Q_{0t} + 0.5(Q_{1t} - Q_{0t})] \tag{3-37}$$

where P_{1t} is the equilibrium price with automation, P_{0t} is the equilibrium price without automation, Q_{1t} is the equilibrium quantity with automation, Q_{0t} is the equilibrium quantity without automation and MC_t and AC_t are defined as before. Since Π_t is a measure of 'processor's producer surplus,' by definition it is the difference between total revenue and total variable costs. Thus, fixed obligations such as interest charge on long-term debt are not deducted. Thus, the change in the producers' surplus may be given as:

$$\Delta PS_t = (w_{1t} - w_{0t})[X_{0t} + 0.5(X_{1t} - X_{0t})] \tag{3-38}$$

where w_{1t} is the equilibrium input price after automation, w_{0t} is the equilibrium input price without automation, X_{1t} is the equilibrium input quantity after automation, and X_{0t}

is the equilibrium input quantity before automation. The change in the members' welfare (ΔW) after automation can then be given as:

$$\Delta W = \Delta\Pi + \Delta PS_t \tag{3-39}$$

In addition to the members' welfare as a measure of the performance of the co-operative firm, the Sharpe Ratio (SR) is used to measure the risk-adjusted return on assets (Sharpe, 1966). Thus, SR is a measure of the rate of return per unit of risk. Alternatively, the Sharpe Ratio is frequently used to determine which investments offer the most return for a given amount of risk. The *ex post* Sharpe ratio is given as:

$$SR = \frac{\overline{\Omega}}{\sigma_\Omega} \tag{3-40}$$

where $\overline{\Omega} = \frac{1}{T}\sum_{t=1}^{T}\Omega_t$ is the average value of Ω_t over the historic period t=1 through T=15, $\Omega_t = ROA_t - R_t^F$ is the differential returns in period t, $\sigma_\Omega = \sqrt{\frac{\sum_{t=1}^{T}\left(\Omega_t - \overline{\Omega}_t\right)}{T-1}}$ is the standard deviation over the period t, ROA_t is the return on assets in time period t, and R_t^F is the return on a risk free investment (e.g., T-Bill) in time period t. Theoretically, the value of SR depends on the relative size of the change in returns and standard deviation that results from an increase in leverage. If the magnitude of the increase in the returns is greater than the increase in the standard deviation, SR increases with leverage, and vice versa. In general, as the degree of leverage increases, the standard deviation of the returns continues to increase, but the returns may not continue to increase proportionately because the potential losses may begin to outweigh the benefits from borrowing.

In the following section, the results for a single decision maker are reported and discussed. To investigate the impact of divergence in risk attitudes and decision-making power on the performance of the firm for multiple decision makers case, the analytical hierarchy process is employed. A diagrammatic depiction of the impact of the decision maker risk attitude and power is given in Figure 3-8. In the diagram, DMs' risk attitudes and decision making power are modeled to directly influence the debt to equity ratio of the firm. An increase in the debt level is assumed to be used to finance the automation process. The shaded boxes indicate the direction of the flow of debt. For example, borrowing increases the level of cash available for investment in fixed assets whereas increasing capacity enables the firm to boost its production.

3.6.6.2.4 Results and Discussion: Single Decision Maker Case

Using 15 years of firm level data, the impact of capital investment on the sales and raw material requirement is established based on the following simple regression results:

$$\begin{aligned} X_t &= \underset{(0.654)}{20086704} + \underset{(7.017)}{4.07}{*}K_t + e_t \qquad R^2 = 0.791 \end{aligned} \tag{3-41}$$

$$\begin{aligned} Q_t &= \underset{(0.288)}{1504282} + \underset{(71.602)}{1.582}{*}X_t + e_t \qquad R^2 = 0.997 \end{aligned} \tag{3-42}$$

where X_t, K_t and Q_t are defined as before.

The above regression outputs are based on historical data. Any additional long-term borrowing is assumed to increase the level of capacity by the same amount, which is a very stringent assumption. The implication of an increase in debt on loan repayment and interest charge is also modeled in a financial statement spreadsheet. The level of borrowing is defined as a function of decision maker's degree of risk aversion (Equation 3-27).

For the illustrative co-operative agribusiness firm, the mean (μ_{ROA}) and standard deviations (σ_{ROA}) of return on assets are calculated to be 0.0761 and 0.00346, respectively. Based on equation 3-28, for an interest rate of 7 per cent, then the range of the admissible values for the coefficient of the relative risk aversion (λ) is [0.0108, 1.8967]. The range in the coefficient of the relative risk aversion may suggest different levels of debt to equity ratio[16]. If the managers and directors differ in their degree of risk aversion (e.g., a manager with λ=0.011 and a director with λ=1.900); then they may propose and implement different levels of debts. Results from the TpB model presented earlier in this chapter tend to indicate that managers may be less likely to increase the level of debt in order to finance the automation process implying that, in terms of borrowing, managers may be more risk averse. For the purpose of this illustrative analysis, four different levels of relative degrees of risk aversion (λ_1= 0.54, λ_2 =0.63, λ_3= 0.75, and λ_4=0.94) are assumed. Further, it is assumed that the initial members' equity is $10,000,000 and that there is a 7 per cent interest rate on debt. For the calculation of the Sharpe ratio, the risk free interest rate is assumed to be 2.5 per cent (T-bill rate). To estimate the producers' surplus and co-operative profits, price elasticities from different studies are gathered and reported in Table 3-29.

Using this information and equation 3-27, the resulting debt to equity ratios and their impacts on producers' surplus are given in Table 3-30. Table 3-30 depicts the potential impact of a single decision maker's degree of risk aversion on firm performance. In this analysis, the degrees of relative risk aversion affect the debt to equity ratio directly as defined in equation 3-27. In turn, the debt to equity ratio influences the level of investment in plant automation and expansion. Plant automation and expansion have an impact on the level of the o-operative's output and the demand for raw material (Figure 3-8). Finally, the changes in the supply of the co-operative's output and the demand for the raw material from members may result in a change in the co-operative's profits and producers' surplus.

In terms of the level of debt, the director may think that $20 million ($\lambda$=0.63) should be borrowed whereas the manager may consider $10 million debt ($\lambda$=0.94) to be appropriate/"optimal" for financing plant automation. In this case, the manager may not approve a debt level above $10 million because he/she may not be sure about the expected benefits from additional debt whereas the directors think higher debt level would add more to the welfare of the members. Figure 3-9 depicts the relationship between the decision maker's degree of the relative risk aversion and the present value of producer surplus, the present value the profits of the co-operative and the Sharpe ratio. An increase in the degree of the relative risk aversion results in a decrease in the present values of producer's surplus and profits. However, the return on assets per unit of risk, as measured by the Sharpe ratio, increases with the degree of relative risk aversion. These illustrative results indicate that the greater the degree of risk exposure, the higher the expected return is.

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[16] Risk averse individuals will sacrifice some level of expected return to reduce the probability of loss. Risk taking individuals will prefer alternatives with some probability of high return. Risk neutral individuals would prefer alternatives with higher expected return regardless of the associated probabilities.

Figure 3-10 shows the relationship between the potential debt to equity ratio and the producers' surplus, co-operative profits, and Sharpe ratio. As leverage increases, expected performance, as measured by producer surplus and co-operative profits, may increase. However, the risk adjusted co-operative performance may decline with the increase in the degree of financial leverage.

It is possible that the managers and directors of a co-operative may each have their own motivations and, hence, they may be in conflict on certain issues. This conflict of interest may delay the process of decision-making and, hence, the actual automation of the plant. The final decision may depend on the individual decision-making power and influence, and the degree of group consensus. Therefore, it is important that the differences in preference and decision making power be understood and that mechanisms and procedures for describing and handling them be developed and applied. In order to draw conclusive policy recommendations, this illustrative example suggests a need for further investigation of the effects of risk attitudes on co-operative firm performance.

3.6.6.2.5 Multi-Criteria Decision Analysis (MCDA)

The issues surrounding group decision-making and the potential conflicts may be addressed using a multi-criteria decision analysis approach. A key feature of a multi-criteria decision analysis is its emphasis on the judgment of the decision making team, in establishing objectives and criteria, estimating relative importance weights and, to some extent, in judging the contribution of each option to each performance criterion. A major challenge in the multi-attribute analysis is obtaining the weights and values using an appropriate method. The multiple-criteria decision analysis augments active participatory decision-making that is more acceptable to both the management and directors of a co-operative. It has the potential to accommodate conflicting interests between decision makers.

A multi-attribute analysis involves measurement of weights and values for each attribute associated with an attractive option. Algebraically, the overall utility of alternative z can be expressed as: $U(x) = \sum_{i=1}^{n} w_{zi} v_{zi}$, where w_{zi} is the weight (i.e., importance) of attribute i for alternative z and v_i is the value of the attribute for alternative z. The multiple-criteria decision analysis covers a wide range of approaches: linear additive models, multi-attribute utility theory (Keeney and Raiffa, 1976), multi-attribute value theory (Dyer et al., 1992), analytical hierarchy process (Saaty, 1980), goal programming, and outranking, among others. In this study the analytical hierarchy process approach is used as a decision rule in developing the relative decision making weights for members of the co-operative business management and directors team.

The analytical hierarchy process (AHP) is one of the techniques that can be used to group decision-making problems (Saaty, 1980). The AHP enables decision-makers to structure a complex problem in the form of a hierarchy of its elements and to capture managerial preferences through pair-wise comparisons of the relevant factors or criteria.

3.6.6.2.6 The Analytical Hierarchy Process (AHP)

An analytical hierarchy process (AHP) is a decision-aiding technique developed by Saaty (1980; 1990). The AHP provides a means of making decisions or choices among alternatives, particularly where a number of objectives have to be satisfied (multiple criteria or multi-attribute decision making). In other words, the AHP helps in quantifying relative priorities or weights for a given set of alternatives on a ratio scale based on the judgment of the decision makers (Saaty, 1980). The AHP has been applied to evaluate alternative projects and business strategies in diverse contexts, including merger and acquisition process evaluation (Arbel and Orgler, 1990), the best house purchase choice (Saaty, 1990), capital budgeting (Kwak et al., 1996), and potential acquisitions evaluation (Hogan, 1999) and resource allocation problems (Ramanathan and Ganesh, 1995). The strength of the AHP is that it organizes tangible and intangible factors in a systematic way, and provides a structured yet relatively simple solution to the decision-making problems (Saaty, 1980).

There are four steps required in applying the AHP (Saaty, 1980; Saaty, 1990): (i) define the problem and determine its goal; (ii) structure the problem as a hierarchy from the top level decision (e.g., the members' welfare maximization in the case of co-operatives) to the lowest level decision (e.g., the alternative debt policies); (iii) elicit a set of pair-wise comparison judgments by using the relative scale measurement depicted in Table 3-31. This scale has been empirically and theoretically validated for its effectiveness (Saaty, 1990). In this study, the pair-wise comparisons are done first in terms of which decision makers is dominated (e.g., a scale of 9 if the manager extremely dominates the director in the decision making process)[17]. Next, the prioritization of the alternative debt to equity ratio is made based on the subjective judgements of the managers and directors, independently. There are n(n-1) judgments required to develop the set of matrices, where n is the number of items or aspects to prioritize. Reciprocals are automatically assigned in each pair-wise comparison. More generally, in the standard AHP model there are n(n-1)/2 comparisons to be performed. In our illustrative example since there are four debt-to-equity ratios to be compared, six comparisons for the prioritization of debt to equity ratios are requires. Because there are two decision makers, one comparison for decision making power is required. and (iv) Having made all the pair-wise comparisons, the consistency[18] of the pair-wise comparison matrix is determined by using the maximum eigenvalue, λ_{max}, as follows: $CI=(\lambda_{max}-n)/(n-1)$, where n is the dimension of the matrix. Judgment consistency can be checked by using the consistency ratio (CR). The CR as a measure of consistency of the pair-wise comparisons is defined as: CR=(CI/ACI)x100; where ACI is the average CI of the randomly generated comparisons. The CR reflects the consistency of the pair-wise judgements and shows the degree to which various sets of importance relativities can be reconciled into a single set of weights. For example, if d_i is larger than d_j, d_j is larger than d_k, and d_k is larger than d_i, the consistency score would be poor, and this would be considered a violation of the axiom of transitivity. The AHP tolerates inconsistency through the amount of redundancy of judgements. The CR is acceptable, if it does not exceed 0.1. If it is higher, the judgment matrix is normally considered unacceptable. To obtain a consistent matrix, judgments should be reviewed and improved. In a perfectly consistent situation, the maximum eigenvalue is equal to n.

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[17] Ideally elicitation of decision makers' judgment is based on a survey.

[18] In the standard approach, one does not ask for both a comparison of d_i with d_j and of d_j with d_i because answers are assumed *a priori* to be consistent, i.e. $a_{ij} = 1/a_{ji}$, i.e. the upper triangular part is inverse symmetric.

The AHP technique enables the formation of a pair-wise comparison matrix A in order to determine the relative importance of various alternatives in achieving the specified goal. The element for the alternative in the i-th raw and j-th column of A gives the relative importance of the alternative i as compared to alternative j. Saaty (1980) suggested a scale from 1-9 with $a_{ij} = 1$ if i and j are equally important, $a_{ij} = 9$ if i is extremely more important than j (Table 3-31).

The matrix $A = [a_{ij}]$ has positive entries everywhere and satisfies the reciprocal property $a_{ji} = 1/a_{ij}$. A pair-wise comparison matrix for n items can be given as:

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{pmatrix} = \begin{pmatrix} 1 & a_{12} & \cdots & a_{1n} \\ 1/a_{12} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ 1/a_{1n} & 1/a_{2n} & \cdots & 1 \end{pmatrix}$$

where a_{ij} is the relative importance of alternative i as compared to alternative j; $a_{ij} = 1 \; \forall \; i = j$; and $a_{ij} = 1/a_{ji} \; \forall \; i \neq j$. For example, if the number of decision makers to be compared in terms of their decision making power is equal to 2, A will be a 2x2 matrix with 1s along the main diagonal depicting comparison of a decision maker with itself. In this case, one comparison must be made. In general, if there are n decision makers to be compared, a total of $\frac{n(n-1)}{2}$ comparisons are required. In the following section, an illustrative AHP approach is applied to alternative debt financing strategies.

3.6.6.2.7 Results and Discussion: Team Decision Makers Case

Basically, the AHP approach gathers input judgments of managers and directors in the form of a matrix by pair-wise comparison of criteria (e.g., debt levels) using a survey questionnaire. The relative importance of alternative capital structures can be structured in a hierarchy as in Figure 3-11. In this formulation, the overall goal of the co-operative business is specified as maximization of members' welfare which appears at the top of the hierarchy. Next to the overall goal of the co-operative business, decision makers are identified in order to investigate their relative power in influencing the financing strategies. The final level in the hierarchy deals with the debt policies that reflect different degrees of risk exposure.

The DMs' objective function is shown on the first level of the hierarchy. Decision makers' relative power appears on the second level in the hierarchy: managers and directors. The DMs are compared with respect to their degree of relative power in influencing the overall company goal. Questions such as: "*which of the following two actors has more relative power in shaping the capital structure of the co-operative at this point in time, and if so, to what extent?*" may be asked to assess the DMs' relative power in shaping and directing debt policy/strategy of the co-operative. The assessment of the relative power in influencing strategic decision making of the co-operative firm may be gathered from this pair-wise comparison. The matrix providing the relative decision-making power, which in turn useful in computing the relative weights in decision-making process, may be given by:

$$P = \left(\begin{array}{lccc} & \text{Manager} & \text{Director} & \text{Priority} \\ \text{Manager} & 1 & p_{12} & p_{12}/(1+p_{12}) \\ \text{Director} & 1/p_{12} & 1 & 1/(1+p_{12}) \end{array} \right) \quad \text{where } p_{ij} \in [1/9, 9]$$

For example if p_{12} equals 1/9, illustrating that the director has more power than the manager in influencing strategic decision making. Form the above matrix this yields:

$$P^D = \left(\begin{array}{lccc} & \text{Manager} & \text{Director} & \text{Priority} \\ \text{Manager} & 1 & 1/9 & 0.10 \\ \text{Director} & 9 & 1 & 0.90 \end{array} \right)$$

The priority column in the above matrix indicates that the "hypothetical" director may dominate the debt policy with a priority weight of 0.90, while the "manager" has a priority weight of 0.10. In the strategic management literature these types of directors are referred to as "proactive boards" (Pearce and Zahra, 1991). Proactive boards are characterized by the relative decision-making power that surpasses that of their managers. Other types of directors' typology include "caretaker boards", "statutory boards" and "participative boards". Caretaker boards are *characterized by low board power... [and] are usually dominated by company managers* (Pearce and Zahra, 1991:137). In this study, the value of p_{12} may be assumed to be 7, suggesting that the managers have moderately a higher power than the directors. Statutory boards often function as *rubber stamps of managerial decisions, and do not thoroughly examine managerial decisions because of the lack of expertise or interest* (Pearce and Zahra, 1991: 137). In the case of the statutory board type, the company is characterized by powerful managers. Thus, the value of p_{12} may be assumed to be 9 indicating stronger managerial power over the board. Finally, the participative boards are *characterized by discussion, debate, and disagreement. Differences in opinion are resolved by a vote, a majority vote prevailing* (Vance, 1983:9). The participative boards style may be thought of as a situation whereby the board and the managers are characterized by an equal or a balanced power (i.e, $p_{12}=1$).

Alternative levels of debt appear at the level of the hierarchy. Alternative capital structures may be compared with regard to the extent to which they are important for each decision maker[19]. All other things being equal, theoretically for a single decision maker different long-term debt financing policies can be adopted based on its financial risk attitude. The question that arises relates to what weights should be assigned to individuals with diverse risk attitudes that are involved in a group decision-making process. Matrix D provides an example of preference by the directors and managers for four different debt policies. The four debt policies are D_1, D_2, D_3, and D_4 representing debt to equity ratios of 1.00, 1.50, 2.00 and 2.50, respectively. Matrix D illustrates two individual decision makers' preferences for four debt to equity ratios to compute the relative weights.

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[19] The manager/director answers questions such as: "Is debt to equity ratio of 1.00 better than debt to equity ratio of 2.00, and if so, to what extent". For each criterion, every possible combination of two alternatives is judged in this way. The other criteria or characteristics of an alternative should not be considered in making the pairwise comparisons with respect to one particular criterion.

$$D = \left(\begin{array}{ccccc} DM & D_1 & D_2 & D_3 & D_4 \\ D_1 & 1 & d_{12} & d_{13} & d_{14} \\ D_2 & 1/d_{12} & 1 & d_{23} & d_{24} \\ D_3 & 1/d_{13} & 1/d_{23} & 1 & d_{34} \\ D_4 & 1/d_{14} & 1/d_{24} & 1/d_{34} & 1 \end{array}\right) \text{ where } d_{ij} \in [1/9, 9]$$

Suppose now that for a particular director, a leverage ratio of 2.5 is absolutely preferred to a leverage ratio of 1 based on his/her risk preferences. The pair-wise comparisons for a hypothetical director and manager are given in the following matrices:

$$D^D = \left(\begin{array}{ccccc} \text{Director} & D_1 & D_2 & D_3 & D_4 \\ D_1 & 1 & 1/9 & 1/7 & 1/5 \\ D_2 & 9 & 1 & 1/3 & 1/5 \\ D_3 & 7 & 3 & 1 & 1/3 \\ D_4 & 5 & 5 & 3 & 1 \end{array}\right) \qquad D^M = \left(\begin{array}{ccccc} \text{Manager} & D_1 & D_2 & D_3 & D_4 \\ D_1 & 1 & 5 & 7 & 9 \\ D_2 & 1/5 & 1 & 3 & 5 \\ D_3 & 1/7 & 1/3 & 1 & 3 \\ D_4 & 1/9 & 1/5 & 1/3 & 1 \end{array}\right).$$

D^D represents a situation whereby the directors prefer a higher financial leverage, i.e., the directors are more risk taking than the managers with regard to borrowing; and D^M represents a risk averse manager. The eigenvalues of matrices D^D and D^M provide priority vectors for the director and the manager, respectively. The priority vectors that are derived for each debt policy matrix are calculated as [0.051, 0.177, 0.266, 0.506] for the director and [0.643, 0.208, 0.101, 0.048] for the manager; that is,

$$D^P = \left(\begin{array}{ccc} & \text{Director} & \text{Manager} \\ D_1 & 0.051 & 0.643 \\ D_2 & 0.177 & 0.208 \\ D_3 & 0.266 & 0.101 \\ D_4 & 0.506 & 0.048 \end{array}\right)$$

The results in D^P indicate that the hypothetical director gives more weight to D_4 whereas the hypothetical manager thinks that D_1 is a better/safe choice. The next step in the AHP approach is to obtain the aggregate weights for the alternative debt policies by pre-multiplying the financing strategies priority matrix by decision-making power priority matrix; that is,

$$\begin{pmatrix} 0.900 & 0.100 \end{pmatrix} \begin{pmatrix} 0.051 & 0.177 & 0.266 & 0.506 \\ 0.643 & 0.208 & 0.101 & 0.048 \end{pmatrix} = \begin{pmatrix} 0.103 & 0.160 & 0.267 & 0.470 \end{pmatrix}$$

This result shows that D_4 is given an overall priority weight of 0.470 while D_1 is given an overall priority weight of only 0.103. Table 3-30 depicts the relationship between the degree of risk aversion, debt to equity ratio and optimal borrowing.

Thus, the optimal debt level that incorporates the risk attitudes of a group of decision makers and their relative decision making power is $20,526,543; that is,

$$\begin{pmatrix}10000000 & 15003078 & 20003409 & 25005282\end{pmatrix}\begin{pmatrix}0.103\\0.160\\0.267\\0.470\end{pmatrix} = \$20{,}526{,}543$$

This solution may reflect the preferences/judgments and the influences of multiple decision makers and their differences in the degree of risk aversion. If the DMs are not satisfied with the above solution, new global weights may be computed.

The next important step in the AHP technique is to perform sensitivity analysis to determine if the final recommendations are sensitive to certain judgments, assumptions, or assumed operational environments during the course of the analysis (Arbel and Orgler, 1990). The sensitivity analysis may include, among others: (i) changing the relative power of DMs and observing what effect, if any, can be traced to the bottom level (debt policy options); (ii) introducing an environmental scenario as an additional hierarchy (e.g., an expanding economy with strong competition, stable economy with strong competition, etc.) and members' welfare; and (iii) modeling and changing the relative risk.

Since the objective of this study is to investigate the impact of divergence in the attitudes of decision makers on the performance of the co-operative business, sensitivity analysis on the relative power of DMs and degree of divergences in risk attitudes is carried out. In Table 3-32, different the degrees of divergences/similarities in risk attitudes between managers and directors are provided. The following results should be considered with care as the analysis is conducted for illustrative purposes only.

Table 3-33 presents a summary of the scenarios investigated. Note that the status quo is zero debt level. In scenario I, it is assumed that both the directors and managers are risk averse; in scenario II, it is assumed that the managers are risk averse but the directors are risk taking; in scenario III, it is assumed that the managers are risk taking but the directors are risk averse; and in scenario IV, it is assumed that both the managers and directors are risk taking. Scenarios II and III show the cases where the managers and directors diverge in terms of their risk attitudes.

The following weights are assumed, based on the degrees of risk aversion:

$$D^P = \left(\begin{array}{lcc} & \text{RiskTaking} & \text{RiskAverse} \\ D_1 & 0.042 & 0.654 \\ D_2 & 0.155 & 0.204 \\ D_3 & 0.286 & 0.096 \\ D_4 & 0.517 & 0.046 \end{array}\right)$$

The results in Table 3-34 present the impact of divergence in risk attitudes and differences in decision-making power on the performance of the co-operative. For a proactive board style, the decision-making power weight priority matrix may given as:

$$\left(\begin{array}{lc} & \text{Priority} \\ \text{Manager} & 0.10 \\ \text{Director} & 0.90 \end{array}\right)$$

In the case of a proactive board type, directors have more weight/power in decision-making process. For a proactive board style, both the degree of risk aversion and the divergence in risk attitudes may matter when there are differences in decision-making power between managers and directors. Assuming a favourable economic environment, the illustrative simulation indicates that the higher the decision making power and the propensity to take risks are, the higher the debt levels, the net profit, the producer surplus, and the total welfare[20] are. In this case, more influential individuals may dominate the final decision-making.

For a participatory board style, the decision-making power weight priority matrix may be given as:

$$\begin{pmatrix} & \text{Priority} \\ \text{Manager} & 0.50 \\ \text{Director} & 0.50 \end{pmatrix}$$

The illustrative simulation outcomes for the participative board style indicate that the degree of risk aversion may matter more than the divergence in risk attitudes do.

A caretaker board style represents a situation whereby the directors are dominated by the power and influence of the managers. For a caretaker board style, the decision-making power weight priority matrix may be given as:

$$\begin{pmatrix} & \text{Priority} \\ \text{Manager} & 0.875 \\ \text{Director} & 0.125 \end{pmatrix}$$

As in the case with a proactive board style, both the degrees of risk aversion and the divergence in risk attitude may matter when there are differences in decision-making power between managers and directors. Contrary to a proactive board style, the final decision-making may be dominated by the managers.

For a statutory board style, the decision-making power weight priority matrix may be given as:

$$\begin{pmatrix} & \text{Priority} \\ \text{Manager} & 0.900 \\ \text{Director} & 0.100 \end{pmatrix}$$

The above matrix shows a situation whereby the directors are totally dominated by the managers. As is the case with the proactive and caretaker board styles, both the degree of risk aversion and the divergence in risk attitudes may matter when there are differences in decision-making power between managers and directors. As opposed to both the proactive and caretaker board styles, the final decision-making may be dominated by managers. Figure 3-12 presents the relationship between directors' decision making power and the change in members' welfare resulting from plant automation that is financed by additional borrowing.

In summary, from the above hypothetical results it can be illustrated that (i) given the decision making power, the members' welfare (as a sum of co-operative profits and producers surplus) may increase as the degree of risk aversion decreases; (ii) for a given level of decision making power, the return on asset per unit of risk may decrease as the degree of risk aversion decreases; (iii) the degree of decision making power may not matter if the managers and the directors have the same degree of risk aversion (Scenario I and IV); (iv) if the directors are more risk taking, the co-operative members' welfare may increase with the increase in their decision making power (Figure 3-12) and; (v) the returns per unit of risk may decrease with the decision making power (Figure 3-13). These results are based on the assumption that the degree of risk aversion and debt to equity ratio are inversely related. In turn, debt to equity ratio and returns are assumed to be positively related, assuming that the return on asset is greater than the costs of capital. The bottom line is that the impact of the divergence in risk attitudes on the performance of the firm may depend, among other things, on the degree of divergence in decision-making power. The question is then: "*who has more influence on the strategy formulation process in the co-operative firms*? For example, Hammond Ketilson (1988) assessed the influence of the directors, member and managers on strategy formulation process based on data from 64 retail co-operatives in western Canada. Results revealed that the directors and members have greater influence on strategy formulation in smaller retail co-operatives, while mangers have greater influence in larger retail co-operatives (Hammond Ketilson, 1988). Although the above illustrative evidence is not conclusive, it suggests that further research is warranted through a comprehensive survey of decision makers in co-operative firms across different industries.

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[20] As long as the co-operative generates returns which exceed the cost of debt capital, leverages enhance returns. At the same time, leverages accentuate variability in returns.

3.7 Concluding Remarks

The purpose of this paper is to investigate the potential impact of differing risk attitudes on co-operative performance. The differences in the risk attitudes of the managers and directors of the co-operative agribusiness firms are examined using a direct mail survey method. A dynamic deterministic simulation is applied to illustrate the potential influence of the differences in risk attitudes and decision-making power on firm performance. For the sample respondents, there are statistically significant differences in attitudes towards long-term borrowing between managers and directors. There are also statistically significant differences in risk preference. The evidence in this study may not be sufficient to draw strong conclusion since the analysis is limited by the sample size. While the results are not conclusive in terms of the differing risk attitudes, they appear to confirm that further study in this area should be pursued. Given the results from the small sample and the illustrative simulation, it is critical to undertake a comprehensive study whereby decision makers across different industry are involved.

The differences in attitudes may result in agency problems. These differences, if not resolved, may result in significant costs of resolving conflicts (agency costs), or may hamper the success of the co-operative business. The conflicts in preferences among decision makers may delay the process of decision-making and, hence, may negatively affect the actual business performance. The simulation results in this study illustrate that the impact of differences in risk attitudes may depend on the degree decision-making power.

"Findings" from this study have several managerial implications. First, given results from other studies (e.g., agency costs; Hailu et al., 2004), the differences in DM's attitudes may affect corporate financial risk management. Tufano (1998) found that the degree of managerial risk aversion affected corporate risk management policy in the

North American gold mining industry. Demsentz and Lehn (1985) and Jensen and Meckling (1976b) stated that if managers' holdings are substantial, their motivations become aligned with those of shareholders and the agency problem is reduced. In the case of co-operative businesses, where managers have no equity holdings in the business, the motivations of the managers and directors/members may not be very well aligned. Thus, the differences in risk attitudes may be expected. Second, acknowledging and aligning the differing DMs' attitudes through technical support may facilitate the optimization of the overall co-operative goals. Hence, the evidence from the survey may suggest a need for technical support for co-operative decision makers in the area of financial risk management. Finally, given the limitation of this study, further research may allow an assessment of the robustness of these results.

Results from the ordered probit model suggest that favourable attitudes towards long-term borrowing and frequent gambling behaviour are positively related to the probability of intending to increase long-term borrowing. On the contrary, subjective norm (social pressure) and perceived behavioural control (confidence) each have a negative influence on the likelihood of intending to increase long-term borrowing.

Although the results from this study are not conclusive due to the small sample size, they provide some directions and suggestions for future research. The 20 per cent "indirect" mail response rate is disappointing although not unusual. The 4 per cent response rate at the co-operative level, however, is unsatisfactory. The lower response rate for direct mail method is in line with those achieved in other related studies that used this method. For example, MacCrimmin and Wehrung (1986) achieved a direct mail response rate of 7 per cent (509/3530) in the study of differences in risk attitudes between Canadian and American top executives. However, they were able to achieve a higher response rate of (i.e., approximately 48 per cent, 215/450) when they used a personal contact survey method. Future extensions to this study may consider using the personal contact approach in order to increase the response rate.

Further research that is geared towards answering the following question is warranted. Do the results in this study extend to a larger and diversified sample of managers and directors? By using an adequate sample size from diverse co-operative types and structure, more confidence may be placed on the representativeness of the results.

Table 3-1. Survey Response at Different Stages

Co-op Type [A]	Letter and Fax [B]	Co-op Willing to Participate [C] – (B/A)[a]	Number of Questionnaires Sent [D]	Number of Co-op Returned Filled Questionnaire [E] –(E/C)	Number of Questionnaires Returned [F] –(F/D)
130	82	5 (6.1)	51	3 (60)	11 (22)
140	36	2 (5.6)	11	2 (100)	3 (27)
150	109	8 (7.3)	55	5 (63)	14 (25)
180	5				
260	21				
270	1				
271	31	1 (3.2)	8	1 (100)	1 (13)
272	24				
273	6				
280	7				
290	56				
300	9				
310	8				
320	37	2 (5.4)	14	1 (50)	1 (7)
	431	18 (4.2)	139	12 (67)	30 (22)

a: Figures in parentheses are percentage.

Table 3-2[21]: Survey Questions for the Stochastic Dominance Approach

Suppose that you have decided to invest $10,000 in either Business A or Business B. For the following two scenarios, indicate the Business that you would choose (A or B) given the information provided:

Scenario I[22]: Would you prefer A or B if the potential dollar gain or loss one month from now for each is as follows?

Business A		Business B	
Gain (+) or loss (-)	Likelihood of occurrence	Gain (+) or loss (-)	Likelihood of occurrence
-$500	⅓	-$500	½
+$2500	⅔	+$2500	½

Please circle A or B

Scenario II: Would you prefer A or B if the potential dollar gain or loss one month from now is as follows:

Business A		Business B	
Gain (+) or loss (-)	Likelihood of occurrence	Gain (+) or loss (-)	Likelihood of occurrence
-$500	¼	$0	½
+$500	¼		

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[21] Adapted from Levy and Levy (2001).

[22] All DMs with non-decreasing utility functions (concave, convex, or with both concave and convex segments) prefer A to B.

Table 3-3: Expected Value and Variance of a Random Outcome of Investment in Two Alternative Businesses

		Scenario I		Scenario II			
Business A	X	-500	2500	-500	500	1000	2000
	Prob(X=x)	0.33	0.67	0.25	0.25	0.25	0.25
	E(X)		1500				750
	V(X)		2312500				812500
Business B	X	-500	2500	0	1500		
	Prob(X=x)	0.50	0.50	0.50	0.50		
	E(X)		1000		750		
	V(X)		2312500		562500		

Table 3-4: Survey Questions for the Willingness to Pay for Lottery Tickets Approach

Suppose you are given a ticket for a lottery in which the number of participants and the dollar value of the prize are specified. Please indicate how much you would be willing to pay for each ticket in the following lotteries.

Lottery	Number of Participants	Chances of winning (α)	Prize (X_i)	I would be willing to pay (\$)(WTP)
I	10	1 in 10	\$1,000	
II	5	1 in 5	\$1,000	
III	10	1 in 10	\$5,000	
IV	5	1 in 5	\$5,000	
V	100	1 in 100	\$100,000	
VI	50	1 in 50	\$100,000	

Table 3-5: Background Information for Eliciting Debt Leveraging Risk Attitudes of Decision Makers

Assume a company with the following characteristics:

Assets:	\$200.4 million.
Total liabilities:	\$150 million
Existing Long-Term debt:	\$100 million.
Proposal:	To ensure survival it is necessary to expand the current capacity by 10 per cent over two years.
Costs of expansion:	The expansion is expected to cost approximately \$50.4 million.

Table 3-6. Impacts of Alternative Business Expansion Financing Options on Company Risk Exposure

	Ex ante Expansion Situation	*Ex post* Expansion Situation [a] (percentage of Debt for Expansion)				
	Initial	0	25	50	75	100
Total Assets ($000,000)	200.4	250.8	250.8	250.8	250.8	250.8
Long-term Debt ($000,000)	100	100	112.6	125.2	137.8	150.4
Total Liabilities ($000,000)	150	150	162.6	175.2	187.8	200.4
Total Equity ($000,000)[b]	50.4	100.8	88.2	75.6	63	50.4
Liabilities/Equity Ratio	2.98	1.49	1.84	2.32	2.98	3.98
Long-term Debt to Equity Ratio	1.98	0.99	1.28	1.66	2.19	2.98

a: Each option involves a $50.4 million expansion. The options differ according to the degree to which debt financing is used.

b: Total Equity is calculated as Total Assets – Total Liabilities.

Table 3-7: Sample Question for Direct-Measure of Attitudes

"In my opinion, financing business expansion using 100 per cent long-term debt is:"

Very bad	Bad	Somewhat bad	Neutral	Somewhat good	Good	Very good
-3	-2	-1	0	+1	+2	+3

Table 3-8: Sample Question for Outcome Evaluation and Belief Strength

Outcome Evaluation: *"Increasing expected returns to shareholder/member equity is:"*

Very bad	Bad	Somewhat bad	Neutral	Somewhat good	Good	Very good
-3	-2	-1	0	+1	+2	+3

Belief Strength: *"If I approve 100 per cent long-term debt financing of expansions it will increase expected returns to shareholder /member equity"*

Very unlikely	Unlikely	Somewhat unlikely	Neutral	Somewhat likely	Likely	Very likely
-3	-2	-1	0	+1	+2	+3

Table 3-9: An Example of Decision makers' Beliefs about Long-term Debt Financing of Business Expansions

		Outcome Evaluation	Belief Strength	Product
1.	Increasing expected returns to shareholder/member equity	5	5	25
2.	Overcoming capital constraints problems	7	5	35
3.	Benefiting from the tax deductibility of interest charge	2	4	8
4.	Increasing likelihood of bankruptcy	5	6	30
5.	Increasing profit	3	1	3
6.	Increasing financial risk exposure	3	2	6
7.	Reducing future flexibility	3	2	6
8.	Making a safe investment	4	6	24
			Sum	137

Table 3-10. A Sample Question for Eliciting Respondents' Normative Belief

Normative Belief: *"My colleagues think that I should approve long-term borrowing for business expansion"*						
Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely
-3	-2	-1	0	+1	+2	+3
Motivation to Comply: *"Doing what my colleagues think is"*						
Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely
1	2	3	4	5	6	7

Table 3-11: Subjective Norm for a Specific Person

	Motivation to comply	Normative beliefs	Products
1. Colleagues	5	0	0
2. Shareholders/ members	3	1	3
3. Senior management	4	2	8
4. Boards of directors	5	2	10
5. Spouse	1	3	3
6. Friends	4	0	0
7. Parents	4	0	0
		Sum	24

Table 3-12: Sample Control Belief and Control Power Questions

Control Belief: *"If I want to have more decision-making power I can easily find out"*						
Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely
1	2	3	4	5	6	7
Control Power: *"I could approve long-term debt to finance business expansion more easily if I had more decision-making power"*						
Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree
-3	-2	-1	0	+1	+2	+3

Table 3-13: Perceived Behavioural Control

Control factor	Perceived power	Control Belief	Product
Decision-making power	2	1	2
Tax-benefits of borrowing	2	1	2
Risks of borrowing	2	-1	-2
Benefits of borrowing	2	-1	-2
Debt maturity structure	2	1	2
Likelihood of occurrences of bankruptcy	3	1	3
Level of equity reserve	4	2	8
Attitudes of shareholders/members towards borrowing	5	-1	-5
Extent of interest rate risk exposure	5	-1	-5
Term structure of interest rates	4	1	4
Costs of borrowing	5	1	5
Level of competition	6	-2	-12
The shareholders'/members' financial commitment	6	-2	-12
		Sum	-12

Table 3-14: General Multi-Attribute Attitude Statements Used in the Survey

Statement
1. When making investment decisions, I am **willing to accept** more risk to achieve higher returns and reach shareholder/member goals.
2. After I make a significant business and financial decision, I normally **feel optimistic** that the decision I made will provide substantial benefits to shareholders/members.
3. When it comes to business decision-making, I **like borrowing** to fund strategies although debt increases investment risks.
4. In business, my **main concern** is the security of shareholders/members. Keeping **the company's money safe** is more important than earning higher returns with risk.
5. I really don't let financial risk **govern** decisions when borrowing money to overcome capital constraints.
6. Debt financing risk has made many companies **paranoid** about excessive debt financing.
7. **Safety** is my main concern when borrowing money from banks and other sources, even when the expected benefit to the shareholders/members is very high.
8. After Dairyworld, one of the largest farmer-owned western Canadian co-operatives was sold to a private company I **worried** more about the survival of my company.
9. Debt financing is **a strategy** to increase the return on equity despite the fact that it increases investment risks.
10. There is a serious **financial risk exposure** problem due to excessive debt financing in my company.
11. I generally **like** to suggest trying out new ideas.
12. I find making decisions about taking on additional debt **difficult** when there is limited information.

These items were followed by a choice of eight items "Very Strongly Disagree, Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree, Very Strongly Agree, No opinion."

Table 3-15. Sample Respondents' Characteristics

Characteristics	Number	Percentage
Director	16	53
Manager	14	47
Male	28	93
Female	2	7
Age, > 54	9	30
Education, > High school	20	67
Income, >CAN$100,000	15	50
Supply Co-operatives	28	93
Marketing Co-operatives	2	7

Table 3-16: Distribution of Sample Respondents by Activity

Activity	Number of Responses	Percentage
Agricultural Supply	11	37
Feed Mill	3	10
Farm Petroleum	14	47
Fruit Growers	1	3
Flower Growers	1	3

Table 3-17: A Contingency Table for DMs Risk Attitudes towards Alternative Risky Business Investment (N=30)

	Directors	Managers	Total
"Risk-averse"	8	2	10
"Risk-taking"	8	12	20
Total	16	14	30
Fisher's Exact Test		P - value = 0.045	

Table 3-18: Co-operative Managers and Directors "Willingness to Pay" for Lottery Ticket with Different Expected Values (N=26)

Lottery[c]		Overall	Managers	Directors	Mann-Whitney U Test	
	Expected Value ($)	(Mean, $)	(Mean, $)	(Mean, $)	Z-score	P-Value
L(1000,0.1)	100	34.23	23.07	47.25	-1.29	0.20
L(1000,0.2)	200	64.50	44.86	87.42	-1.41	0.16
L(5000,0.1)	500	142.00	95.14	196.67	-1.14	0.26
L(5000,0.2)	1000	255.96	164.64	362.50	-1.17	0.24
L(100000,0.01)	1000	255.60	215.71	306.36	-0.22	0.82
L(100000,0.02)	2000	443.04	360.71	547.82	0.00	1.00

Note: c: L(x,α) is a lottery with prize x with probability of winning of α.

Table 3-19: Frequency Distribution (%) of Risk Attitudes of Managers and Directors

Lottery[c]		Risk Loving	Risk Neutral	Risk Averse	$\overline{\rho}$[d]
L(1000,0.1)	Managers	7.14	0.00	92.86	0.001541
	Directors	0.00	25.00	75.00	0.001339
L(1000,0.2)	Managers	7.14	0.00	92.86	0.001616
	Directors	0.00	18.75	81.25	0.001404
L(5000,0.1)	Managers	7.14	7.14	85.71	0.000301
	Directors	0.00	6.25	93.75	0.000313
L(5000,0.2)	Managers	7.14	7.14	85.71	0.000310
	Directors	0.00	6.25	93.75	0.000335
L(100000,0.01)	Managers	0.00	7.14	92.86	0.000017
	Directors	0.00	12.50	87.50	0.000015
L(100000,0.02)	Managers	0.00	7.14	92.86	0.000017
	Directors	0.00	12.50	87.50	0.000016

Note: c: L(x,α) is a lottery with prize x with probability of winning of α. d: $\overline{\rho}$ defines the Arrow–Pratt measure of absolute risk aversion in terms of the parameters of the lottery in the survey.

Table 3-20: Nonparametric Kendall's Tau_b Rank Correlation of risk aversion (ρ)

	L(1000,0.1)	L(1000,0.2)	L(5000,0.1)	L(5000,0.2)	L(100000,0.01)	L(100000,0.02)
L(1000,0.1)	1.000					
L(1000,0.2)	0.956	1.000				
L(5000,0.1)	0.841	0.854	1.000			
L(5000,0.2)	0.805	0.844	0.957	1.000		
L(100000,0.01)	0.569	0.587	0.657	0.653	1.000	
L(100000,0.02)	0.455	0.496	0.557	0.575	0.854	1.000

Note that all correlation coefficients are statistically significant at the 95 per cent confidence level.

Table 3-21: Tests for Differing Attitudes towards Additional Long-term Borrowing (N=30)

T-test for Equality of Means		Nonparametric Test	
Mean Difference (Manager-Director)	-1.923	Mann-Whitney U	57.5
t-statistics	-2.424	Wilcoxon W	162.5
Degrees of freedom	28	Z	-2.269
P-value	0.022	P-value	0.023

Table 3-22. Differences in Risk Attitudes between Co-operative Managers and Directors (N=30)

	Managers	Directors	Mann-Whitney U Test	
Items representing Co-operative Leaders' Risk Attitudes	(Mean)	(Mean)	Z-score	P-value
When making investment decisions, I am willing to accept more risk to achieve higher returns and reach shareholder/member goals.	0.29	0.69	-0.54	0.59
After I make a significant business and financial decision, I normally feel optimistic that the decision I made will provide substantial benefits to shareholders/members.	2.00	1.88	-0.55	0.58
When it comes to business decision-making, I like borrowing to fund strategies although debt increases investment risks.	-0.93	0.00	-2.44***	0.01
In business, my main concern is the security of shareholders/members. Keeping the company's money safe is more important than earning higher returns with risk.	0.79	0.00	-1.95**	0.05
I really don't let financial risk govern decisions when borrowing money to overcome capital constraints.	-1.07	-0.69	-0.55	0.59
Debt financing risk has made many companies paranoid about excessive debt financing.	0.43	0.34	-0.11	0.91
Safety is my main concern when borrowing money from banks and other sources, even when the expected benefit to the shareholders/members is very high.	0.57	0.38	-0.43	0.67
After Dairyworld, one of the largest farmer-owned western Canadian co-operatives, was sold to a private company I worried more about the survival of my company.	-1.21	-0.94	-0.43	0.67
Debt financing is a strategy to increase the return on equity despite the fact that it increases investment risks.	0.64	1.13	-1.38	0.17
There is a serious financial risk exposure problem due to excessive debt financing in my company.	-1.93	-1.88	-0.70	0.48
I generally like to suggest trying out new ideas.	1.93	1.19	-2.19**	0.03
I find making decisions about taking on additional debt difficult when there is limited information.	1.64	2.13	-1.61*	0.11

Table 3-23: Determinants of Risk Attitudes towards Risky Alternative Business Investment (N=30)

Variables	Model A	Marginal Effects	Model B	Marginal Effects	Model C	Marginal Effects
Intercept	0.268 (0.432)	---	-0.047 (-0.088)	---	0.600 (1.105)	---
Manager	-0.634 (-1.037)	-0.154	--- ---	---	-0.951* (-1.727)	-0.272
Age Old	1.211* (1.884)	0.294	1.409** (2.313)	0.365	--- ---	---
Income High	-0.361 (-0.612)	-0.088	-0.304 (-0.533)	-0.079	-0.091 (-0.173)	-0.026
Education High	-1.064* (-1.809)	-0.258	-1.096* (-1.918)	-0.284	-0.961* (-1.789)	-0.274
Scaled R^2	0.371		0.338		0.254	
S.B.I.C	21.762		20.609		21.968	
LLF	-13.259		-13.807		-15.166	
PCP	0.767		0.767		0.767	

Note: * and ** refers to statistical significance at 90 per cent and 95 per cent confidence level, respectively. PCP: Fraction of Correct Predictions. Figures in parentheses are t-statistics. Manager = 1, if a manager, 0 otherwise; Age old = 1, if age > 54, 0 otherwise; Income High =1, if income > $100,000, 0 otherwise; and Education high =1, if > high school, 0 otherwise.

Table 3-24: Multiple Regression Estimates of Determinants of Attitude, Subjective Norms and Perceived Behavioural Control (N=30)

Variable	Attitude		Subjective norm		PBC	
Intercept	19.734***	(4.124)	3.371	(1.339)	25.561***	(3.061)
Manager	-14.008***	(-2.980)	-4.538*	(-1.834)	-16.600**	(-2.024)
Age Old	-16.676***	(-3.225)	-0.600	(-0.221)	-12.881	(-1.427)
Income High	-1.903	(-0.392)	-3.174	(-1.242)	8.177	(0.965)
Education High	-1.980	(-0.437)	-0.140	(-0.059)	-6.647	(-0.841)
R^2	0.373		0.176		0.217	

Note that Manager = 1, if a manager, 0 otherwise; Age old = 1, if age > 54, 0 otherwise; Income High =1, if income > $100,000, 0 otherwise; and Education high =1, if > high school, 0 otherwise. Figures in parentheses are t-statistic. ***, **, &*, represent 99 per cent, 95 per cent and 90 per cent confidence level, respectively.

Table 3-25: Factors Affecting Behavioural Intention to Approve Additional Borrowing to Finance New Investment: Model I, Model II and Model III (N=30)

Variables[e]	Model I Willingness to approve		Model II Tax-benefits		Model II: Equity only	
Intercept	1.285*	(1.668)	5.028***	(3.473)		
A	0.050**	(2.234)	0.103***	(2.994)	1.836***	(2.246)
SN	-0.005	(-0.108)	-0.111*	(-1.828)	-0.061***	(-2.630)
PBC	-0.022*	(-1.794)	-0.004	(-0.202)	0.134***	(2.870)
PB	0.022**	(1.937)	0.005	(0.304)	-0.015	(-1.362)
Manager	0.285	(0.651)	-1.318	(-1.317)	-0.036***	(-2.543)
Age Old	-0.235	(-0.509)	-2.728***	(-2.463)	0.874	(1.023)
Income High	-0.739	(-1.343)	-1.597***	(-3.165)	0.237	(0.271)
Education High	0.146	(0.294)	-0.526	(-1.054)	0.579	(1.292)
μ_2	0.355	(1.458)	1.178**	(2.091)	0.474	(0.987)
μ_3	1.305***	(3.154)	1.953***	(3.654)	1.356***	(4.009)
μ_4	1.553***	(3.387)	6.062***	(5.350)	3.477***	(6.226)
μ_5	2.509***	(4.384)	7.268***	(6.873)		
μ_6	3.272***	(4.987)				
Log likelihood	-45.395		-20.941		-27.564	
Schwarz B.I.C.	69.203		43.049		46.271	
R^2	0.490		0.747		0.413	

e: Standard Errors computed from analytic first and second derivatives. Note: A: attitude; SN: Subjective Norm; PBC: Perceived Behavioural Control; PB: Previous gambling behaviour; Manager = 1, if a manager, 0 otherwise; Age old = 1, if age≥54, 0 otherwise; Income High =1, if income >$100,000, 0 otherwise; and Education high =1, if > high school, 0 otherwise. Figures in parentheses are t-statistic. ***, **, & *, respectively, represent 99 per cent, 95 per cent and 90 per cent confidence level.

Table 3-26: Differences in Familiarities with Risk Management Strategies between Managers and Directors (N=30)

	Managers (Mean)	Directors (Mean)	Mann-Whitney U Test[e] Z-score	Mann-Whitney U Test[e] P-value
Insurance	1.29	1.06	-0.57	0.61
Derivatives	-1.43	-0.93	-0.90	0.40
Forward cash contract	-0.36	0.25	-1.19	0.26
Futures market	-0.07	0.69	-1.37	0.21
Options	-0.21	0.44	-1.08	0.31
Currency swap, cap, floor or collar	-1.07	-1.00	-0.09	0.95
Interest rate swap, cap, floor or collar	-1.14	-0.94	-0.41	0.70
Commodity price swap, cap, floor or collar	-1.43	-0.88	-0.89	0.40
Leasing/renting	1.21	1.44	-1.02	0.38
Investment diversification	0.57	1.13	-1.55	0.15
Deferred or Delayed Price Contract	-0.43	0.69	-2.41**	0.02
Hedge-to-Arrive (HTA) Contract	-1.07	-0.56	-0.98	0.35

e: Note that ** represents 95 per cent confidence level.

Table 3-27: Importance Rating of Risk Factors (1= not important at all, 7 = highly important)

Risk Factors	N	Overall[a]	Managers	Directors	Mann-Whitney U Test[e]	
		(Mean)	(Mean)	(Mean)	Z-Score	P-value
Weather risk	29	5.76 (1)	5.77	5.75	-0.37	0.71
Commodity price risk	29	5.03 (4)	5.00	5.06	-0.30	0.77
Inventory spoilage risk	30	3.67 (16)	3.79	3.56	-0.13	0.90
Livestock disease risk	27	4.82 (5)	4.55	5.00	-0.25	0.80
Debt Leverage risk	27	4.30 (10)	3.83	4.67	-1.35	0.18
Interest rate risk	28	3.89 (15)	3.50	4.19	-1.30	0.19
Loss of key personnel risk	30	4.67 (6)	4.93	4.44	-1.01	0.31
Data accuracy risk	28	4.46 (8)	4.67	4.31	-0.66	0.51
Technology risk	28	4.00 (13)	4.58	3.56	-1.78	0.07
Regulatory risk	26	3.96 (14)	4.33	3.64	-1.27	0.20
Credit risk	29	5.69 (2)	6.23	5.25	-2.02**	0.04
Net return variability risk	26	4.35 (9)	3.83	4.79	-1.23	0.22
Foreign exchange risk	25	2.80 (17)	2.82	2.79	-0.48	0.63
Property damage/losses risk	28	4.21 (11)	4.08	4.31	-0.45	0.65
Input supply risk	26	4.15 (12)	4.08	4.21	-0.11	0.92
Market place competitiveness risk	27	5.222 (3)	5.167	5.267	-0.57	0.57
Business risks	27	4.556 (7)	4.545	4.563	-0.23	0.81

Note that, a: the numbers in parentheses represent rating of risk factors. e: ** represents 95 per cent confidence level.

Table 3-28: Ratings of Effectiveness Risk Management (1= not effective at all, 7 = highly effective)

Risk Factors	N	Overall	Managers	Directors	Mann-Whitney U	
		(Mean)	(Mean)	(Mean)	Z-score	P-value
Weather risk	27	4.07	3.62	4.50	-2.10**	0.04
Commodity price risk	28	4.29	4.15	4.40	-0.02	0.98
Inventory spoilage risk	29	4.62	4.93	4.33	-1.15	0.25
Livestock disease risk	27	3.63	3.67	3.60	-0.15	0.88
Debt Leverage risk	26	4.92	4.67	5.14	-0.82	0.41
Interest rate risk	27	4.37	4.58	4.20	-0.71	0.48
Loss of key personnel risk	28	4.29	4.23	4.33	-0.14	0.89
Data accuracy risk	28	4.68	4.69	4.67	-0.07	0.94
Technology risk	26	4.50	4.75	4.29	-0.85	0.39
Regulatory risk	25	4.08	3.67	4.46	-0.98	0.33
Credit risk	28	4.86	4.85	4.87	-0.26	0.79
Net return variability risk	25	4.44	4.17	4.69	-0.72	0.47
Foreign exchange risk	23	3.30	3.20	3.38	-0.24	0.81
Property damage/losses risk	27	5.04	4.92	5.13	-0.28	0.78
Input supply risk	25	4.92	4.83	5.00	-0.03	0.98
Market place competitiveness risk	27	4.56	4.33	4.73	-0.72	0.47
Business risks	26	4.38	4.27	4.47	-0.30	0.77

Table 3-29: Retail Demand, Farm supply and Processor Demand Price Elasticities for Poultry Industry

	Estimates	Author(s)
Retail Price Elasticities		
	-0.17	Qian (2004)
	-0.12 -to -0.9	Cranfield (1995)
Farm supply Elasticity		
	1.36	Qian (2004)
	1.51	McNiel and Burbbee (1983)
	1.28	Fulton and Tang (1999)
Processor Demand (Birds)		
	-0.14	Qian (2004)

Table 3-30: Relationship between relative Risk Aversion and 'Optimal' Debt to equity ratio, Total Borrowing, Members Welfare, and Co-operative's Profits

Relative Risk Aversion	D-E	Total Borrowing (Million $)	ΔΠ (Million $)	ΔPS (Million $)	SR
-	0.00	0.00	0.00	0.00	2.27
1.50	0.25	2.45	16.44	9.57	1.79
1.25	0.50	5.00	32.26	19.95	1.34
0.94	1.00	10.00	71.24	41.52	0.71
0.75	1.50	15.00	110.97	64.72	0.32
0.63	2.00	20.00	153.38	89.53	0.09
0.54	2.50	25.00	198.53	115.97	-0.06

Note: ΔΠ, ΔPS, SR are change in co-operative profits, change in producers surplus, and Sharpe Ratio. The changes are the differences between the with debt and the without debt situations.

Table 3-31: Pair-wise Comparison of Scale for AHP Preference

Numerical rating	Verbal judgments of preference	Explanation
1	Equally preferred	Equally contribute to the objective
2	Equally to moderately	
3	Moderately preferred	Moderately Favour one over the other
4	Moderately to strongly	
5	Strongly preferred	Strongly Favour one over the other
6	Strongly to very strongly	
7	Very strongly preferred	Very Strongly Favour one over the other
8	Very strongly to extremely	
9	Extremely preferred	Extremely Favour one over the other

Table 3-32: Relationship between Degree of Risk Aversion, Debt-to-Equity Ratio and Optimal Borrowing

Relative Risk Aversion	D-E	Total Borrowing (CAN $)
0.94	1.00	10,000,000
0.75	1.50	15,003,078
0.63	2.00	20,003,409
0.54	2.50	25,005,282

Table 3-33: Summary of Scenarios for Sensitivity Analysis

Scenarios	Directors	Managers
Status quo	No debt	No debt
Scenario I	Risk Averse	Risk Averse
Scenario II	Risk Taking	Risk Averse
Scenario III	Risk Averse	Risk Taking
Scenario IV	Risk Taking	Risk Taking

Table 3-34: Percentage Changes in Net Profits, Producer Surplus, Total Welfare and Return on Equity Attributed to Borrowing for Different Board Style and Differing Risk Attitudes

Proactive[a]	Scenario I	Scenario II	Scenario III	Scenario IV
Debt Level (Million $)	12.66	20.53	13.54	21.40
ΔPS (per cent)	10.12	17.37	10.89	18.22
$\Delta\Pi_{Coop}$ (per cent)	4.19	7.73	4.51	7.55
Δ(Members' Welfare)(per cent)	6.65	11.42	7.15	11.98
SR (Ratio)	0.54	0.11	0.48	0.08
Participative				
Debt Level (Million $)	12.66	17.03	17.03	21.40
ΔPS (per cent)	10.12	14.06	14.06	18.22
$\Delta\Pi_{Coop}$ (per cent)	4.19	5.82	5.82	7.55
Δ(Members' Welfare)(per cent)	6.65	9.24	9.24	11.98
SR[23] (Ratio)	0.54	0.27	0.27	0.08
Caretaker				
Debt Level (Million $)	12.66	13.75	20.31	21.40
ΔPS (per cent)	10.12	11.08	17.16	18.22
$\Delta\Pi_{Coop}$ (per cent)	4.19	4.28	7.11	7.55
Δ(Members' Welfare)(per cent)	6.65	7.28	11.28	11.98
SR (Ratio)	0.54	0.46	0.12	0.08
Statutory				
Debt Level (Million $)	12.66	13.54	20.53	21.40
ΔPS (per cent)	10.12	10.89	17.37	18.22
$\Delta\Pi_{Coop}$ (per cent)	4.19	4.51	7.73	7.55
Δ(Members' Welfare)(per cent)	6.65	7.15	11.42	11.98
SR (Ratio)	0.54	0.48	0.11	0.08

Note: a: changes (Δ) are relative to status quo.

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[23] The Sharpe ratio is a (performance) measurement of return per unit of risk. The Sharpe ratio is valid if the assets are normally distributed or if the investor has a quadratic utility function.

Figure 3-1: Theory of Planned Behaviour (Ajzen, 1991)

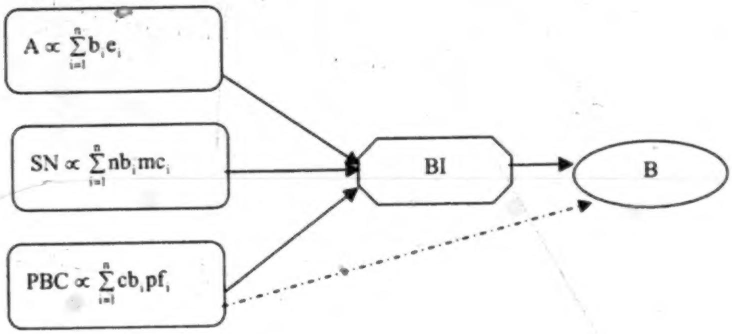

$A \propto \sum_{i=1}^{n} b_i e_i$
$SN \propto \sum_{i=1}^{n} nb_i mc_i$
$PBC \propto \sum_{i=1}^{n} cb_i pf_i$
BI
B

Figure 3-2: Bentler-Speckart Extension to Theory of Reasoned Action

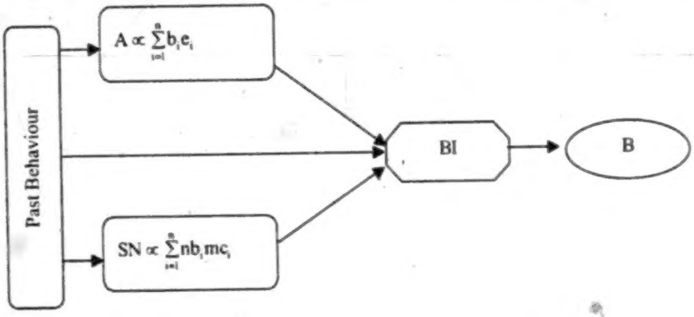

Past Behaviour
$A \propto \sum_{i=1}^{n} b_i e_i$
$SN \propto \sum_{i=1}^{n} nb_i mc_i$
BI
B

Figure 3-3: Extension to the Theory of Planned Behaviour

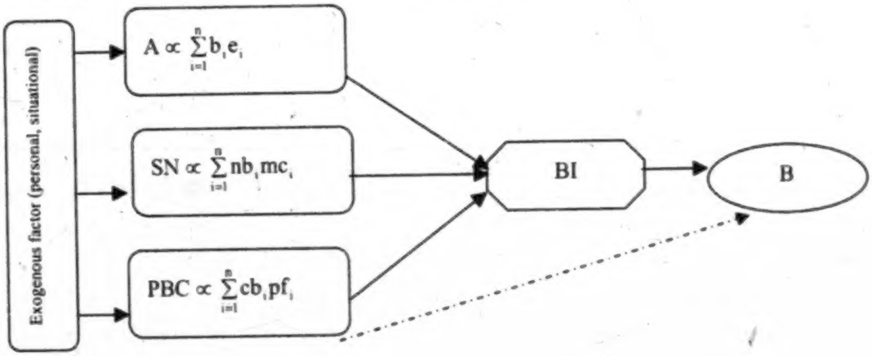

Exogenous factor (personal, situational)
$A \propto \sum_{i=1}^{n} b_i e_i$
$SN \propto \sum_{i=1}^{n} nb_i mc_i$
$PBC \propto \sum_{i=1}^{n} cb_i pf_i$
BI
B

Figure 3-4: Cumulative Distributions for Alternatives in Stochastic Dominance Scenario I: A Dominates B by FSD

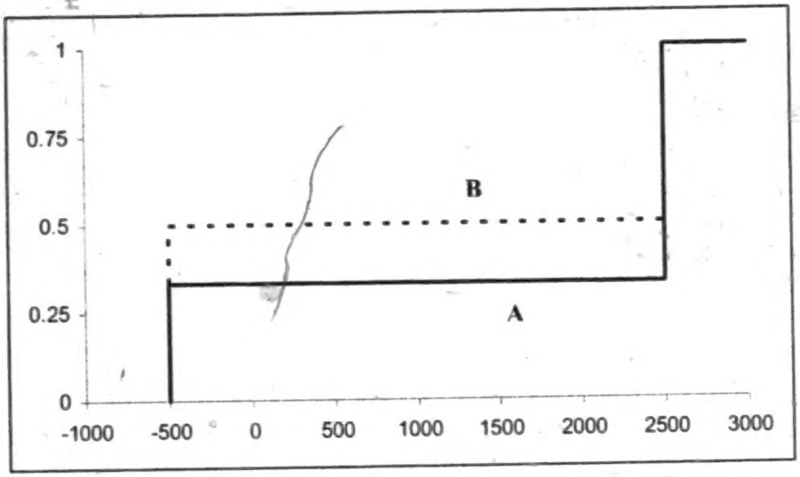


Figure 3-5: Cumulative Distribution for Alternatives in Stochastic Dominance Scenario II: B Dominates A by SSD

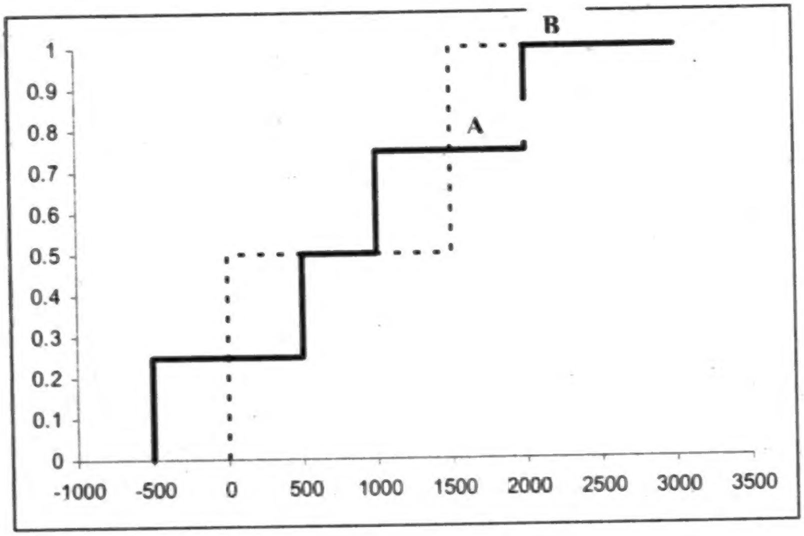


Figure 3-6: Effects of Plant Automation on Processor's Output

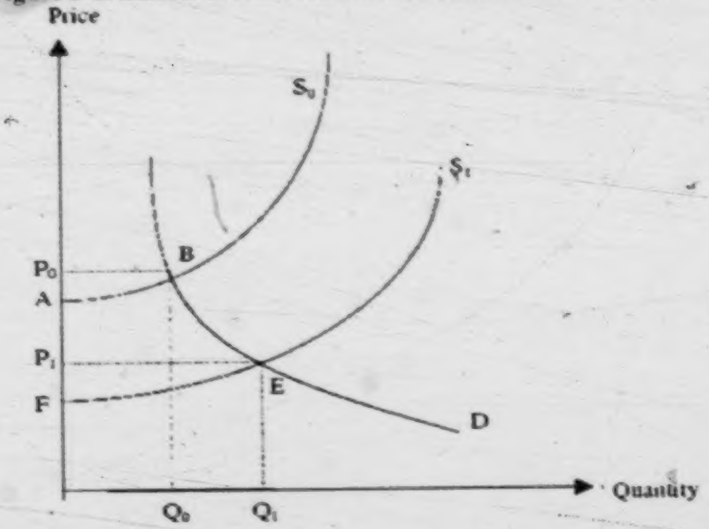

Price
S_0
S_1
B
P_0
A
P_1
E
F
D
Quantity
Q_0
Q_1

Figure 3-7: Effects of Plant Automation on Processor's Raw Material Demand (Birds)

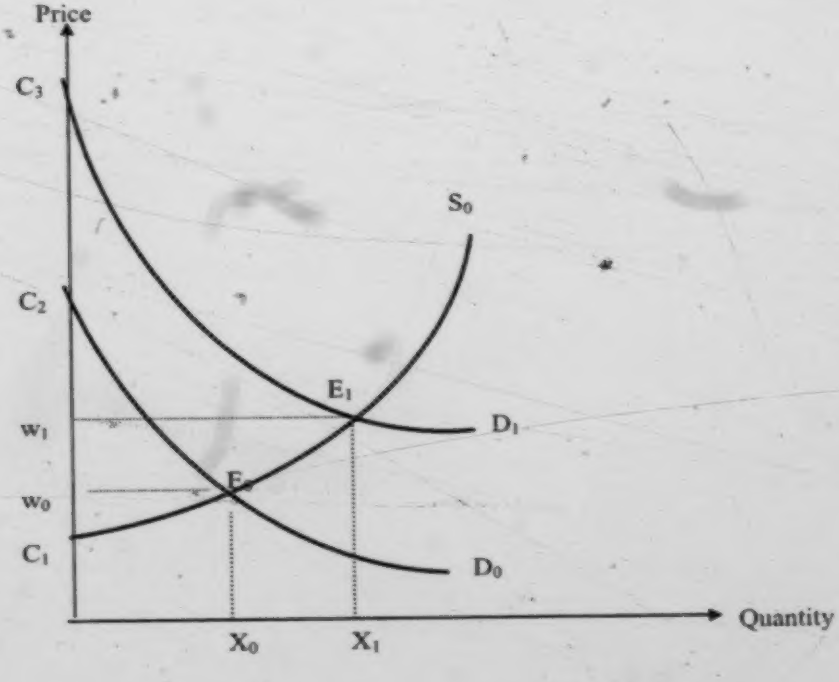
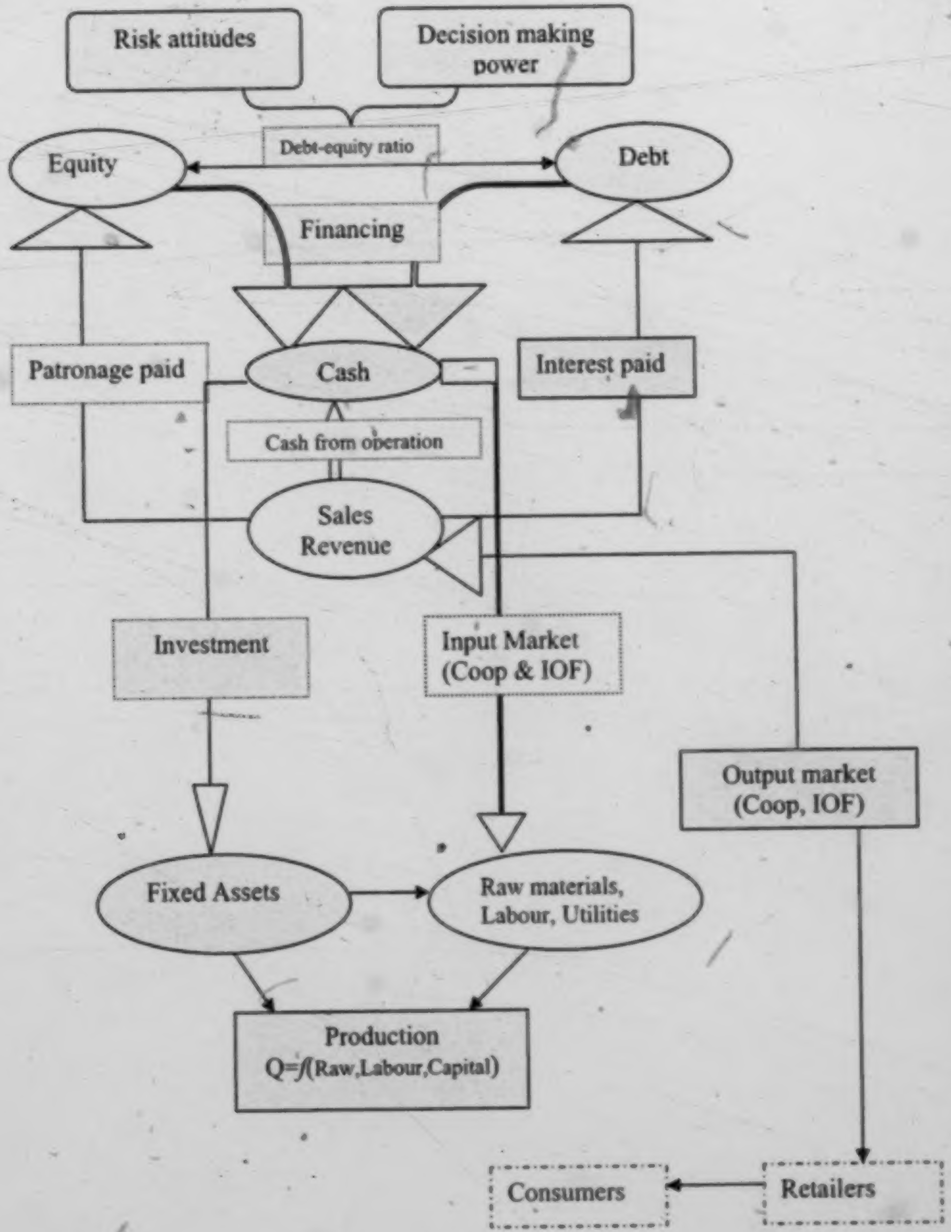
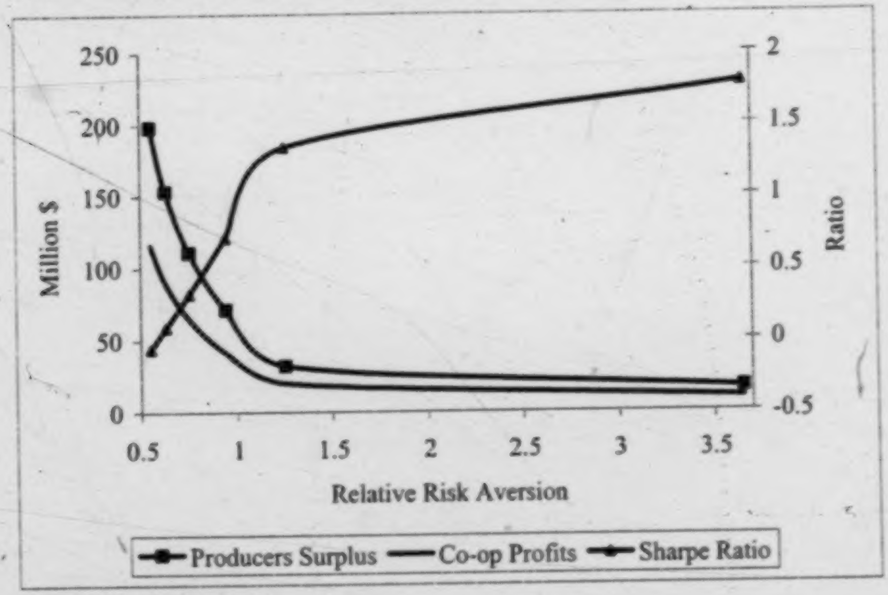

Price
C_3
S_0
C_2
E_1
w_1
D_1
E_0
w_0
C_1
D_0
Quantity
X_0
X_1

Figure 3-8: Diagrammatic Depiction of the Impact of Risk Attitudes and Decision Making Power



Risk attitudes
Decision making power
Debt-equity ratio
Equity
Debt
Financing
Patronage paid
Cash
Interest paid
Cash from operation
Sales Revenue
Investment
Input Market (Coop & IOF)
Output market (Coop, IOF)
Fixed Assets
Raw materials, Labour, Utilities
Production
Q=f(Raw,Labour,Capital)
Consumers
Retailers

Figure 3-9: Relationship between Decision Maker's Relative Risk Aversion and Producer Surplus, Co-operative Profits and Sharpe Ratio



Source: Simulation results

Figure 3-10: Relationship between Debt-to Equity Ratio and Producer Surplus (PS), Co-operative Profits and Sharpe Ratio (SR)

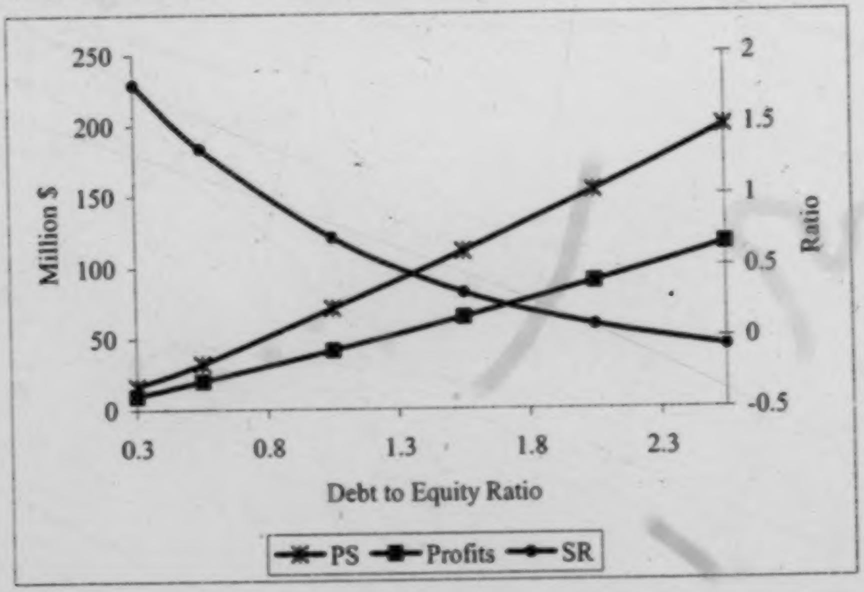


Figure 3-11: AHP Hierarchy for Alternative Debt Policy

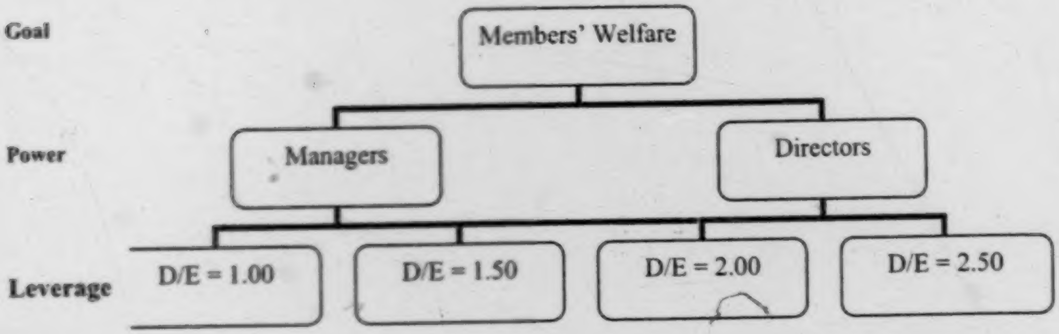
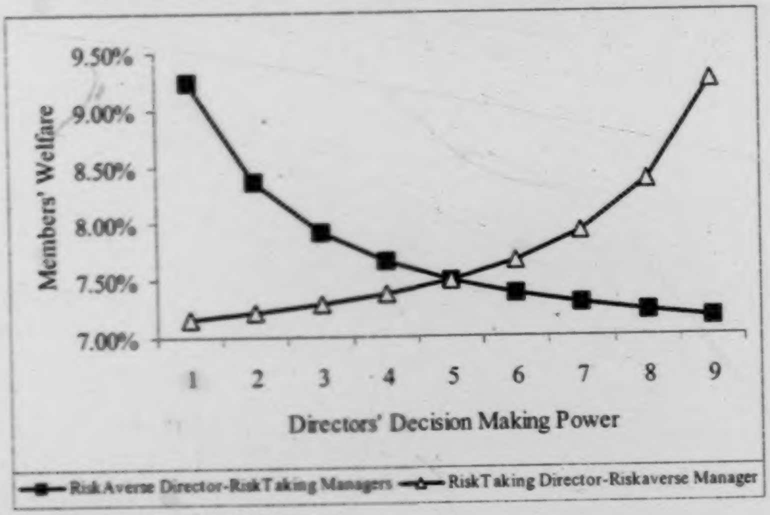
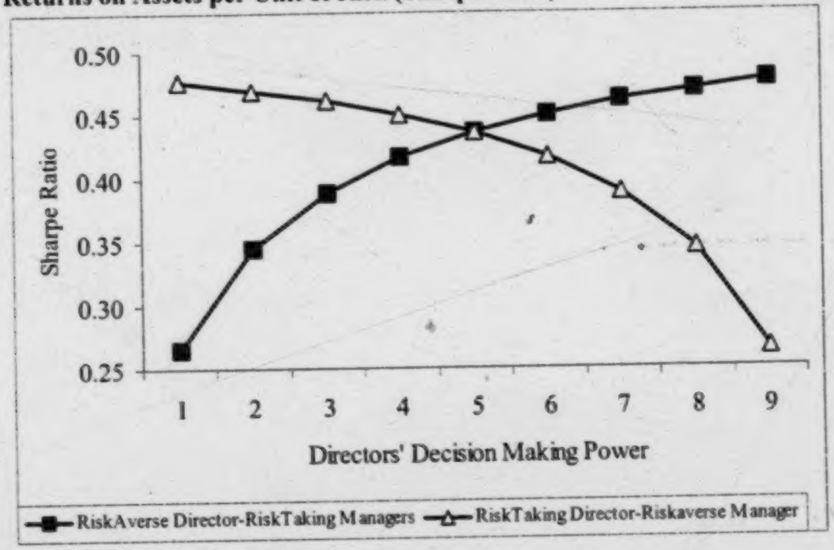

Goal
Members' Welfare
Power
Managers
Directors
Leverage
D/E = 1.00
D/E = 1.50
D/E = 2.00
D/E = 2.50

Figure 3-12: Relationship between Directors' Decision Making Power and Percentage Change in Members' Welfare from Status Quo (Zero Debt)



Source: Simulation Results

Figure 3-13: Relationship between Directors' Decision Making Power and Expected Returns on Assets per Unit of Risk (Sharpe Ratio)



Source: Simulation Results

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Chapter 4: Cost Efficiency of Canadian Agribusiness Co-operatives

4.1 Introduction

The development of efficiency measurement dates back more than five decades (Debreu, 1951; Koopmans, 1951b; Shephard, 1953; Farrell, 1957b; Solow, 1957) with major theoretical and empirical efficiency research advancements occurring in the late 1970's (Aigner et al., 1977; Battese and Corra, 1977; Meeusen and van den Broeck, 1977; Charnes et al., 1978). Since then there have been an increasing number of applications of efficiency analyses across diverse industries and organizational structures. Yet, the application of efficiency models to the agribusiness co-operative sector remains limited.

The use of efficiency scores in the co-operative sector is potentially appealing because of ongoing changes affecting this sector. Over the last 20 years, increased competition from local investor owned firms and multinational companies, deregulation and globalization of trade and increased concentration from suppliers and purchasers have put tremendous competitive pressure on agricultural supply and marketing co-operatives. Improvement in cost or operating efficiency of agricultural supply and marketing co-operatives may be crucial as changes in regulation, technology and other market developments reduce the competitive advantage enjoyed by co-operative businesses, and bring into question their long term viability. As long as co-operative firms are not insulated from competition by mechanisms such as regulation and subsidy, inefficient co-operatives may be unable to continue to survive in the long run, similar to the case for their investor-owned counterparts. The bottom line is that if markets are competitive, inefficient co-operative firms may not remain economically viable. The enhanced level of competitive rivalry may force co-operatives into lowering costs and prices. It is appropriate in this study to estimate cost (in)efficiency because environmental pressures, trade deregulation and globalization, capital constraints all influence the response and effort of co-operative management since intense pressure is expected to lower cost inefficiencies.

Empirical firm efficiency studies can play a prominent role in providing useful information for a variety of groups. Measurement of efficiency scores is helpful to assess the relative performance of firms. Firm efficiency information can then be used by managers, co-operative members, regulators, directors and policymakers. However, to date only a few studies have attempted to empirically measure the efficiency of agribusiness co-operative firms (Chen, 1997; Caputo and Lynch, 1993; Ariyaratne et al., 2000; Singh et al., 2001b) and none have been undertaken in Canada.

Furthermore, although the notion of cost efficiency is one of the most commonly used tools in evaluating performance of firms within the agricultural and food markets, the literature investigating the association between cost efficiency and financial leverage, and firm size is limited. One of the major issues concerning co-operative finance is the influence of debt leverage on co-operative performance. Theoretically, leverage increases the pressure on managers to perform, because it reduces the moral hazard behaviour by reducing "free cash flow" at the disposal of managers (Jensen, 1986a). This suggests a positive relationship between leverage and efficiency. On the other hand, higher leverage may raise agency costs of debt because of the conflicting interests between co-operative shareholders/members and debtholders resulting in a negative relationship between leverage and efficiency (Jensen and Meckling, 1976; Myers, 1977). The theoretical literature therefore provides mixed results regarding the relationship between financial leverage and firm performance. A study of the relationship between financial leverage and performance may provide insights into the impact of differences in access to debt or equity capital on the competitiveness of co-operative firms.

One other issue that warrants scrutiny is the nature of the strength of the relationship between cost inefficiency and financial performance (i.e., profitability) for agribusiness supply and marketing co-operatives. Because co-operatives are characterized by capital constraints (Chaddad, 2001), the impact of cost inefficiency on co-operative firm profitability is of particular interest. Profitability, among other things, determines the ability of the co-operative firm to invest and grow through its contribution to retained earnings. However, cost inefficiency may result in significant lost earnings (i.e., low profitability) due mainly to suboptimal resource use. The undesirable effect on earnings translates into lower co-operative members' welfare through either (i) lower patronage; (ii) lower farm output prices for marketing co-operatives; (iii) higher prices of farm inputs for supply co-operatives; or (iv) lower investment that slows down the co-operative firm's growth. Thus, all other things being equal, it can be argued that profitability and success in the co-operative sector in a highly competitive environment may depend on the decision makers' ability to manage/control costs.

The major objective of this study is to rigorously analyze cost efficiency for a sample of 357 agribusiness co-operative firms in Canada, using panel data over the period 1984-2001. The specific objectives are to: (i) measure cost efficiency of agribusiness supply and marketing co-operatives in Canada using random parameters stochastic frontier models; (ii) investigate the impact of financial leverage and firm size on cost efficiency; and (iii) investigate the relationship between cost inefficiency and profitability.

The contributions of this study are as follows: (i) cost structures of Canadian agribusiness co-operative firms are determined and cost efficiency scores are calculated; (ii) the influence of financial leverage and firm size on cost efficiency is tested; (iii) cost structures are measured that take into account unobserved technological differences across firms; and (iv) the degree of association between efficiency and profitability is explored. In the following sections, a literature review, conceptual models, data description, model results and discussion, and concluding remarks are presented and discussed.

4.2 Literature Review

Over the past two decades empirical firm efficiency analyses have been used increasingly for various industries (e.g., transportation, banking, agriculture, electricity, health, sports, insurance, credit unions, etc.) and across different business structures (e.g. co-operatives, stock companies, public companies, mutual companies, non-for-profit, etc.). At the same time, estimation methods have advanced from simple ratio calculations to advanced econometric and mathematical programming techniques. Applications of this type of analysis have included examinations of the impact of regulations, agency problems, firm risks, firm size, organizational structure, and other variables on firm efficiency. Of the growing numbers of efficiency analyses, however, only a few of them have explored the efficiency of agribusiness co-operatives. Specifically, the efficiency literature concerning Canadian agribusiness co-operatives is very limited.

The efficiency of resource allocation in the economic literature, as it relates to the co-operative sector, is controversial. In the past, several attempts to measure performance of U.S. and other countries' agribusiness co-operative sector have been reported in the literature. Most of these studies relate to a debate around the relative efficiency of co-operatives as compared to investor-owned firms and other forms of ownership (Sexton and Iskow, 1993a; Akridge and Hertel, 1992; Berry, 1994a; Hind, 1994; Zou, 1992; Ferrier and Porter, 1991). Some of these studies have attempted to answer the question: "Are co-operatives more or less efficient than corresponding investor-owned firms?" The property right literature states that inefficiency may arise due to separation of ownership and control in a business (Berry, 1994b; Alchian and Demsetz, 1972), which depends on the ownership structure. For example, Ferrier and Porter (1991), Berry (1994a), Stutzman & Stansell (1992) concluded that co-operative firms are less efficient than investor-owned firms. On the contrary, studies by Zou (1992), and Singh et al. (2001a) found that co-operative firms are more efficient than investor owned firms. Other studies (e.g., Akridge and Hertel, 1992; Sexton and Iskow, 1993b) have claimed the absence of any significant efficiency differences between co-operative and investor-owned firms. From the above, the answer as to the best ownership type (i.e., co-operative versus non co-operative) is mixed and inconclusive.

Another question addressed in the co-operative efficiency literature is: "*what are the significant sources of inefficiency or sources of differences in efficiency across co-operative firms?*" Among the studies conducted over the past 20 years, Caputo and Lynch (1993) analyzed the efficiency of California cotton ginning co-operatives using a nonparametric efficiency methodology and found that the main cause of overall inefficiency to be a lack of technical efficiency. In the U.S., Ariyantne et al. (1997; 1992a) estimated a nonparametric efficiency frontier for Midwestern agricultural co-operatives and found that larger co-operatives are more efficient than smaller co-operatives, and that financial leverage (defined in terms of equity to assets) ratio is not statistically associated with efficiency. Evans and Guthrie (2002) demonstrated that, in theory, economic inefficiency in agribusiness co-operatives arises because of the over-supply of input induced by members responding to average, rather than marginal, revenue. This argument may not apply, however, in supply managed industries such as dairy, and poultry and eggs in Canada.

In Australia, using a sample of credit unions over the period 1982-1993, Esho (2001) found that ignoring subsidies in efficiency analysis biases estimates of cost efficiency and efficiency rankings. As well, Esho concluded that size is a significant determinant of relative cost efficiency. Gorton and Schmid (1999), using Australian co-operative banking as their case, showed that co-operative firm performance declines as the number of members increases. In Germany, Lang and Welzel (1999) examined the impact of mergers among co-operative banks on their efficiency using a stochastic frontier approach, and showed that positive scale and scope effects from a merger arise only if the merged unit closes part of the former branch network. In Japan, Fukuyama et al. (1999) estimated the overall efficiency and productivity growth of credit co-operatives during the period 1992-96 using DEA and concluded that foreign-owned credit co-operatives were more efficient than Japanese-owned credit co-operatives. From the above, depending on the type of study, different factors appear to influence the efficiency of co-operative firms. The current study focuses on the impact of the degree of financial leverage and firm size on the efficiency of Canadian agribusiness co-operatives.

From the above empirical literature review it can be concluded that i) the existing results concerning efficiency of co-operative firms are mixed and inconclusive; ii) the existing studies have not investigated efficiency of co-operative sector across diverse industries; iii) there have been no efficiency studies for Canadian co-operative agribusiness firms; iv) no previous co-operative efficiency study has taken into account heterogeneity across firms; and v) none of the previous co-operative efficiency studies have investigated the extent of the association between efficiency and profitability. This study explores cost efficiency and its determinants for the Canadian supply and marketing agribusiness co-operatives operating in diverse industries.

4.3 Concepts of Efficiency

4.3.1 Efficiency Measurement

In economics, the term "efficiency" is commonly used in a variety of settings (e.g., efficient prices, efficient markets, efficient firms). Generally speaking, economic efficiency refers to scarce resources being used in an optimal fashion. Within production economics, the term efficiency is defined in terms of a firm's ability to convert inputs into outputs and respond optimally to economic signals (i.e., prices). This section provides a brief review of efficiency concepts and measures as they relate to firm production decisions.

Measuring efficiency of a firm is important from both a theoretical and a policy point of view. From an empirical perspective, a policymaker's interest may lie in knowing how far a given firm can increase its output, without using further resources, by increasing efficiency. From a theoretical perspective, interest lies in developing an appropriate measure of efficiency and studying its properties. A great number of studies have been devoted to theoretical development of the relative efficiency measurement of economic units over the past few decades.

Farrell (1957b) proposed a framework to quantify efficiency measures based on the concept of a production frontier. A production frontier is defined as the maximum output that can be obtained from a specified set of inputs, given the existing technology available to the firms (Forsund et al., 1980). The concept of a production frontier is consistent with the "standard" representation of technology; specifically, a production function. Deviations from a production frontier can be interpreted as a measure of inefficiency from a technical perspective. If the output of the firm lies below the frontier, the firm is regarded as being inefficient.

The degree to which a firm is "off" the production frontier is an indication of technical (in)efficiency. According to Färe et al. (1985: pp. 3-4) a producer is said to be technically efficient if production occurs on the boundary of the producer's production possibilities set, and technically inefficient if production occurs on the interior of the production possibilities set. Alternatively, a firm is technically efficient if an increase in any output requires a reduction in at least one other output or an increase in at least one input (Koopmans, 1951a).

A second type of efficiency, as it relates to firm production, is allocative efficiency. Allocative (or price) efficiency refers to the proper (or improper) choice of input combinations, given economic signals. A producer is said to be allocatively efficient if production occurs in a subset of the economic region of the production possibilities set that satisfies the producer's behavioural objective. The location of this subset is determined by the prices faced by the producer and the producer's behavioural goals. Allocative efficiency is measured relative to the efficient production function as the ratio of "optimal" input proportions to the input proportions actually used (French, 1977). A technically efficient producer may be allocatively inefficient if production occurs at the wrong point on the boundary of the economic region of the production possibilities set, where "wrong" is in relation to prices faced by the producer and the producer's behavioural goal.

Technical and allocative efficiency, taken together, contribute to the overall economic efficiency for the firm. If the firm is producing on the production frontier, using the optimal proportions of inputs given relative prices and the firm's behavioural goal, the firm is said to be economically efficient. Economic inefficiency may occur through one or both of technical inefficiency and allocative inefficiency, as defined above. The product of the index of technical efficiency and the index of price efficiency is used as a measure of economic efficiency of the firm. A firm that is efficient both technically and allocatively has an economic efficiency index of 1.0 (Farrell, 1957a).

As stated above, allocative and economic efficiency both require an economic behavioural assumption (e.g., an objective of profit or revenue maximization, or cost minimization). One of the fundamental decisions to be made when measuring efficiency is the choice of concept to use. The two most important economic efficiency concepts that are based on production economic decision making are cost and profit efficiencies. Economic efficiency based on a profit function measures how close a co-operative is to producing the maximum possible profit given a particular level of input prices and output prices. Economic efficiency based on a cost function provides a measure of how close a co-operative's cost is to what a best-practice co-operative's cost would be to produce the same output bundle under the same conditions.

The two approaches differ in terms of some fundamental assumptions. The profit function is specified in terms of variable profits instead of variable costs and takes output prices as given, as opposed to holding output quantities fixed as is the case with the cost function.

Assuming that the level of co-operative processor output is given, the profit or the welfare maximization problem for the co-operative is equivalent to minimizing the short-run total cost function, and hence, the cost function approach may be an appropriate efficiency concept. Therefore, this study focuses on cost minimising behaviour of co-operative firms. In this regard, cost efficiency is an appropriate measure of economic efficiency. Cost efficiency is an economic efficiency associated with the input oriented technical efficiency measure (i.e. output is held constant) (Kumbhakar and Lovell, 2000). As such, cost efficiency is defined as the ratio of the minimum cost of producing the output for the firm in question, assuming complete technical and allocative efficiency, to the actual cost at given input prices and technology.

Using the standard cost function, $C(y;w) = Min\{x.w \mid x \in L(y)\}$, cost efficiency can be defined as: $CE(x,y;w) := \frac{C(y;w)}{x.w}$ [1]. The measure of input allocative efficiency is given by a function: $AE_I = \frac{CE(y,x;w)}{TE_I(y,x)}$, where $TE_I(.)$ is a measure of input oriented-technical efficiency, defined as: $TE_I = [D_I(y,x)]^{-1}$, and $D_I(y,x)$ is an input distance function. From the above, allocative efficiency can be seen as the cost efficiency measure (or overall economic efficiency in general) applied to the technically efficient reference production plan. The measure of cost efficiency is bounded between zero and unity and achieves its upper bound if and only if a producer uses a cost-minimizing input vector.

4.3.2 Stochastic Frontier Model

Empirical results for efficiency measures depend on the approach that is used and on the assumptions imposed under that particular approach. Two major approaches have been developed for measuring efficiency: a mathematical programming approach commonly referred to as Data Envelopment Analysis or DEA, and an econometric approach. Both methods involve estimation of "best practice' frontiers, with the efficiency of a specific decision making unit measured relative to the frontier.

The econometric approach involves specification of a functional form for production, cost, revenue, or profit (Kumbhakar and Lovell, 2000). The methodology is stochastic; firms can deviate from the frontier because they are inefficient or because of random shocks or measurement errors that have nothing to do with efficiency. Thus, the error term associated with the frontier function is hypothesized to consist of an efficiency component and a purely random component. Efficiency is measured by separating the efficiency component from the overall error term. Some variants of the econometric approach require that specific distributional assumptions be imposed on the components of the error terms, while others do not require distributional assumptions. By contrast, the mathematical programming approach places less structure on the frontier and is non-stochastic; that is, any departure from the frontier is measured as inefficiency.

The choice of estimation methodology has been controversial, with some researchers preferring the econometric approach (e.g., Bauer, 1990; Berger, 1993); and others the mathematical programming approach (e.g., Seiford and Thrall, 1990). The econometric approach has been criticized for having the potential to confound estimates of efficiency with specification errors. Mathematical programming is non-parametric and thus less susceptible to specification errors, but does not allow decision-making units to deviate from the frontier due to purely random shocks. This magnifies the impact of outliers on resulting efficiency estimates. Advocates of the econometric approach disagree about whether distributional assumptions should be imposed on the error term and, if so, which distributions are most appropriate. Some recent mathematical programming papers have criticized the prevailing DEA technique and propose instead the free disposal hull (FDH) methodology, arguing that the FDH involves fewer arbitrary assumptions and provides a better fit to the data (e.g.,Tulkens, 1993).

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[1] Efficiency is generally defined relative to the best-practice observed in the industry, rather than any true minimum cost, since the underlying technology is unknown.

The analysis in this study is based on efficient frontier methodology developed by Aigner et al. (1977) and Meeusen and van den Broeck (1977). The approach is stochastic and observations may deviate from the frontier because of inefficiency or because of random shocks or measurement errors. The conceptual framework of the stochastic frontier approach is outlined in the next section.

4.3.3 Conceptual Stochastic Frontier Model

As discussed earlier, in order to measure the efficiency of co-operative firms, a behavioural assumption of cost minimisation is imposed. In this regard, a cost frontier is the appropriate empirical relationship to use in measuring economic efficiency. The general form of a stochastic frontier cost function for panel data may be expressed as (Kumbhakar and Lovell, 2000; Battese and Coelli, 1992b):

$$C_{ft} = C(w_{ft}, y_{ft}; \beta) + (v_{ft} + u_{ft}) \qquad ,f=1,\ldots,F,\ t=1,\ldots,T, \quad (4\text{-}1)$$

where C_{ft} is the actual cost of the f-th co-operative in the t-th time period; $C(w_{ft}, y_{ft}; \beta)$ denotes the theoretical frontier cost function; w_{ft} is a k×1 vector of input prices for the f-th co-operative in the t-th time period; β is a vector of parameters to be estimated; v_{ft} is assumed to be an independently and identically distributed $N(0,\sigma_V^2)$ stochastic error term, and independent of u_{ft}; u_{ft} is assumed to be an independently and identically distributed non-negative truncation of the $N(0,\sigma_u^2)$ distribution, and thus accounts for cost inefficiency in production. The most common distributional assumptions used in efficiency analysis are the normal distribution for v_{ft} and the exponential, truncated normal (usually the half-normal), or gamma distribution for u_{ft}. The above model accommodates both balanced and unbalanced panel data.

The general procedure for estimating cost efficiency using equation (4-1) is to first estimate β and $\varepsilon_{ft} = v_{ft} + u_{ft}$ and then to calculate cost efficiency for each observation in the sample as the conditional expectation $E(\exp(-u_{ft}) | \varepsilon_{ft})$. This provides an estimate of cost efficiency as the ratio of the frontier (i.e., efficient) cost to actual cost. If distributional assumptions are imposed on the error terms, the approach involves determining the density function of ε_{ft}, $f(\varepsilon_{ft})$, and the joint density function $f(u_{ft}, \varepsilon_{ft})$ and then obtaining an expression for the conditional mean of $\exp(-u_{ft})$ based on the distribution $f_u(u_{ft} | \varepsilon_{ft})$. Based on the approach proposed by Jondrow et al. (1982) for disentangling the inefficiency effect and assuming a truncated-normal distribution, $U_{ft} \sim N[\mu, \sigma_u^2]$, for the inefficiency effect, the firm specific inefficiency term is:

$$E[u_{ft} | \varepsilon_{ft}] = \frac{\sigma\lambda}{1+\lambda^2}\left[\frac{\phi(\mu_f/\sigma\lambda - \varepsilon_{ft}\lambda/\sigma)}{1-\Phi(\mu_f/\sigma\lambda - \varepsilon_{ft}\lambda/\sigma)} - (\mu_f/\sigma\lambda - \varepsilon_{ft}\lambda/\sigma)\right] \qquad (4\text{-}2)$$

where $\mu_f = \delta' z$, $\sigma = \sqrt{\sigma_v^2 + \sigma_u^2}$, and $\lambda = \sigma_u / \sigma_v$, z is firm characteristics that affect efficiency, μ_f is the mode/mean of the truncated normal distribution. The above formulation collapses to the half-normal distribution efficiency estimates (Aigner et al., 1977) if $\mu_f = 0$.

Once point estimates of u_f are obtained based on equation (4-2), estimates of the cost efficiency (CE_{ft}) of each co-operative in an industry can be obtained from: $CE_{ft} = \exp(-\hat{u}_{ft})$[2], where $\hat{u}_{ft}$ is an estimate of $E(u_{ft} \mid \varepsilon_{ft})$.

4.4 Econometric Model

4.4.1 Stochastic Frontier

In empirical efficiency studies the most commonly used functional forms are the Translog and Cobb-Douglas forms. The Translog form (Diewert and Wales, 1987) does not impose any technological restriction and allows economies of scale, size and density to vary with output. Flexible functional forms such as the Translog provide a second order approximation to the true underlying (but unknown) technology. For firm f=1,…,F at time t=1,…, T, the stochastic Translog cost function is used in this study:

$$\ln(C_{ft}) = \beta_0 + \sum_i \beta_i \ln w_{ift} + 0.5 * \sum_i \sum_j \beta_{ij} \ln w_{ift} \ln w_{jft} + \sum_i \beta_{iy} \ln w_{ift} \ln y_{ft} +$$

$$\beta_y \ln y_{ft} + 0.5\beta_{yy} \left(\ln y_{ft}\right)^2 + \left(v_{ft} + u_{ft}\right) \tag{4-3}$$

$$u_f = \delta' z_f + \eta_f \tag{4-4}$$

where C_{ft} is the observed cost for the f-th co-operative firm in the t-th time period, w_{ift} is the price for the i-th input of the f-th co-operative firm in the t-th time period (i.e., labour, capital and materials), y_{ft} is output (i.e., value added) for the f-th co-operative firm in the t-th time period, z_f's variables hypothesized to influence efficiency (i.e., financial leverage and firm size); the β's and δ's are parameters to be estimated, and v and u are defined as before. Equations (4-3) and (4-4) are estimated separately in two stages[3], where the first step is to estimate a standard stochastic frontier model (equation 4-3), and the second step is to estimate the relationship between (estimated) u and z (equation 4-4).

Regularity conditions require that the cost function in equation (4-3) be linearly homogeneous, non-decreasing and concave in input prices. For the Translog cost function to satisfy the linear homogeneity property of the cost functions, the following parameter restrictions must hold: $\sum_{i=1} \beta_i = 1$, $\sum_{j=1} \beta_{ij} = 0$ and $\sum_{i=1} \beta_{iy} = 0$.

If the cost function is twice differentiable, a combination of Young's theorem and Shepherd's lemma requires that the cross effects in the set of input demand functions be symmetric. However, rather than applying Young's theorem to the actual cost function to obtain a set of restrictions, it can instead be applied to the Translog approximation, so long as the Translog approximation is twice continuously differentiable over the relevant range. This yields the following set of parameter restrictions: $\beta_{ij} = \beta_{ji}$. Based on statistical tests and theoretical appeal, separate stochastic frontier models are specified for co-operatives based on the industry to which they belong; that is, separate frontiers are estimated for each type of co-operative (i.e., seven frontiers are estimated).

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[2] In a standard stochastic frontier approach, inefficiency is measured relative to the estimated frontier, rather than the best-practice co-operative, that is, relative to zero value for $\hat{u}_{ft}$ which is not achieved by co-operative in the sample.

[3] An alternative approach is to use a one-stage estimation. Wang and Schmdit (2002) argue strongly for one-step estimation whenever one is interested in the effects of firm characteristics on efficiency levels. However, given the complexity of the random parameters model, and a problem with model convergence, the two-stage approached was adopted here.

Estimation of equations (4-3) and (4-4) can be implemented using different stochastic frontier methods: cross-sectional approach, fixed effects and random effects panel data approaches, latent class stochastic frontier approach, and random parameters stochastic frontier approach. The standard modeling approach to econometrically scrutinize the effects of heterogeneity in technology on efficiency across firms is to incorporate a firm specific fixed or random intercept term in the production, cost, or profit function. The fixed effects model is an extension of the basic stochastic frontier model where the constant term is replaced with a complete set of firm dummy variables. One issue is that the estimators of the stochastic frontier model with fixed effects may be persistently biased due to the 'incidental parameter problem'[4] when the time span of the panel is small (Greene, 2002c; Greene, 2002a). With the fixed effects approach, identification may be difficult, since the number of parameters increases with the number of firms.

The random effects model is obtained by assuming that u_f is time invariant and also uncorrelated with the variables included in the model. However, with the random effects specification, one must impose strong distributional assumptions on both v_{ft} and u_{ft}, as well as the unlikely assumption that the u_{ft} are uncorrelated with the explanatory variables. The Hausman (1978) misspecification test can be used to decide whether to use a fixed-effects model or a random-effects model. However, estimation of the frontier with only fixed or random effects in the intercept terms may result in inefficient estimates of the slope coefficients and invalid inferences of the results (Biorn et al., 2002). In addition, both random and fixed effects cost frontier models assume that any unobserved heterogeneity among co-operatives is completely due to their differences in cost efficiency (Farsi and Filippini, 2003). For example, in the fixed effects model, since the fixed firm-specific effects capture both observed and unobserved time-invariant factors, this may lead to underestimation of cost efficiency.

4.4.2 Stochastic Frontier and Heterogeneous Technologies

In the framework discussed earlier, heterogeneity in the distribution of C_{ft} is assumed to impact the density function in the simple form of a random effect model. In practice, firms' technologies may be heterogeneous rather than homogeneous (Tsionas, 2002; Greene, 2002a; Greene, 2002b; Orea and Kumbhakar, 2004; Huang, 2004; Battese et al., 2004; Greene, 2002a). The underlying belief that all firms share the same technology can be challenged, particularly for samples including a large and heterogeneous set of agribusiness co-operative firms. If this assumption is not valid, technological differences may be incorrectly labelled as (in)efficiency. Thus, it would be more appropriate to distinguish technological differences and technology-specific inefficiency rather than simply assume that firms share the same technology (Biorn et al., 2002).

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[4] According to Neyman and Scott (1948), in panel data with T observations per firm and unobservable firm-specific effects, the maximum likelihood estimator of the common parameters in general inconsistent since the fixed effect approach introduces many parameters into the model.

One approach to overcome this problem is to use a two-stage analysis where firms are first segregated into several classes and then separate frontiers are estimated for each class of firms (Berger and Mester, 1997). However, such an approach has the disadvantage of estimating the frontier of a particular class without using information regarding the other classes. To overcome this problem, the Finite Mixture Model (FMM) approach has been used in different studies. FMM was first proposed by Heckman and Singer (1984) for use in duration models and was further extended to stochastic frontier models by Greene (2002a) and the random parameters model.

In this study, the random parameters model is proposed for use. One of the main advantages of random parameters models is their ability to control for unobserved technological heterogeneity among co-operatives. In particular, panel data models provide a better opportunity to control for such heterogeneities. Potentially unobserved technological characteristics may affect production costs but are not necessarily indicative of different efficiencies. The inefficiency measures may therefore be affected by these confounding factors.

4.4.3 The Random Parameters Stochastic Frontier Model

The random parameters stochastic frontier model is applied to accommodate unobserved differences in technologies that might be inappropriately labelled as inefficiency. This heterogeneity in technology can be analyzed through specification of a model of random parameters. As Orea and Kumbhakar (2004) point out:

> *Estimation of [frontier cost] functions rests on the assumption that the underlying production technology is common to all producers. However, firms in a particular industry may use different technologies. In such a case estimating a common frontier function encompassing every sample observation may not be appropriate in the sense that the estimated technology is not likely to represent the 'true' technology. That is, the estimate of the underlying technology may be biased. Furthermore, if the unobserved technological differences are not taken into account during estimation, the effects of these omitted unobserved technological differences might be inappropriately labelled as inefficiency. (pp. 169-170).*

The general random parameters stochastic cost frontier formulation (Greene, 2002a) is as follows:

$$C_{ft} = C(w_{ft}, y_{ft}; \beta_f) + (v_{ft} + u_{ft}), \quad f = 1, \ldots, F, \quad t = 1, \ldots, T, \quad v_{ft} \sim N[0, \sigma_v^2] \qquad (4\text{-}5)$$

Inefficiency Distribution:

$$\begin{aligned} u_{ft} &= |U_{ft}|, \; U_{ft} \sim N[\mu_f, \sigma_{uf}^2] \\ \mu_f &= \delta_f' z_f \\ \sigma_{uf} &= \sigma_u \exp(\gamma_f' q_f) \end{aligned} \qquad (4\text{-}6)$$

Parameter Heterogeneity:

$$\begin{aligned} \beta_f &= \beta + \xi_\beta d_f + \Gamma_\beta \upsilon_{\beta_f} \\ \delta_f &= \delta + \xi_\delta d_f + \Gamma_\delta \upsilon_{\delta_f} \\ \gamma_f &= \gamma + \xi_\delta d_f + \Gamma_\gamma \upsilon_{\gamma_f} \end{aligned} \qquad (4\text{-}7)$$

where C_{ft}, w_{ft}, y_{ft} and β_f are costs of production, input prices, output and the parameter estimates, respectively, for the f-th firm. The parameters β_f are distributed according to a

K-variate normal distribution as: $\beta_f \sim N(\overline{\beta},\Omega)$, f=1,..., F. where $\overline{\beta}$ is a kx1 vector of parameter means, Ω is a K x K positive definite covariance matrix. $\beta_f \mid \overline{\beta},\Omega$ are assumed to be independent. The d_f vector includes variables related to the distribution of the random parameters and these are time-invariant; υ_{jf}, $j=\beta,\delta,\gamma$ parameterize random variation which is assumed to have mean vector zero and known diagonal covariance matrix Σ_j. $\beta_f(\beta, \xi_\beta, \Gamma_\beta)$, δ_f $(\delta, \xi_\delta, \Gamma_\delta)$ and γ $(\gamma,\xi_\gamma, \Gamma_\gamma)$ are matrices of parameters to be estimated; μ_f is the mode/mean of truncated normal distribution ; z_f are operating environmental factors affecting the inefficiency effect; q_f is operating environment variables affecting the variance of the inefficiency effects. The parameter σ_v^2 is variance of v_{ft}, and σ_{uf}^2 is variance of u_{ft}.

In order to estimate the parameters of equations (4-5) to (4-7), the unobserved random term υ_{jf} must be integrated out. Since the integrals will not exist in the closed form, but instead are in the form of expectations, they can be estimated through simulation. Thus, the simulated log likelihood is defined as:

$$\text{LogL}_S = \sum_{f=1}^{N}\frac{1}{R}\sum_{r=1}^{R}\sum_{t=1}^{T}\ln\frac{1}{\sqrt{2\pi}} + \ln\Phi\left(\frac{\mu_{fr}/(\sigma_{ufr}/\sigma_v) \pm [(C_{ft} - C(w_{ft}, y_{ft}))(\sigma_{ufr}/\sigma_v)]}{\sqrt{(\sigma_{ufr}+\sigma_v)}}\right)$$

$$-\ln\Phi\left[\frac{\mu_f}{\sigma_{ufr}}\right] - \ln\sqrt{\sigma_{ufr}^2+\sigma_v^2} - \frac{1}{2}\left(\frac{\mu_f \pm (C_{ft} - C(w_{ft}, y_{ft}))}{\sqrt{\sigma_{ufr}^2+\sigma_v^2}}\right)^2 \quad (4\text{-}8)$$

$$= \sum_{f=1}^{N}\frac{1}{R}\sum_{r=1}^{R}\sum_{t=1}^{T}\log P_{ftr}$$

The maximum simulated likelihood estimator is obtained by maximizing (4-8) over the full set of structural parameters[5]. Firm specific estimates of the parameters, θ_f $[\beta_f(\beta,\xi_\beta, \Gamma_\beta)$, δ_f $(\delta,\xi_\delta, \Gamma_\delta)$ and γ_f $(\gamma,\xi_\gamma, \Gamma_\gamma)]$, etc. are required in order to estimate cost efficiency. Greene (2002a) suggests an estimate of the posterior, conditional mean, for the parameter estimates as follows:

$$\hat{\theta}_f = \frac{\frac{1}{R}\sum_{r=1}^{R}\theta_{fr}\exp\left(\sum_{t=1}^{T}\log P_{ftr}\right)}{\frac{1}{R}\sum_{r=1}^{R}\exp\left(\sum_{t=1}^{T}\log P_{ftr}\right)} = \frac{\frac{1}{R}\sum_{r=1}^{R}P_{fr}\theta_{fr}}{\frac{1}{R}\sum_{r=1}^{R}(P_{fr})} \quad (4\text{-}9)$$

where R is the number of repetitions (i.e., draws of m) on m_{jf}, P_{ft} is the (probability) contribution of the f-th firm at time period t to the likelihood. This can also be computed by simulation during computation of the likelihood function. The firm specific inefficiencies are then based on firm specific expected values of the random parameters.

4.4.4 Inefficiency Effects

Differences in cost efficiency may arise from a variety of sources, including differences in management practices. In the literature, two alternative approaches have been used in previous studies to investigate the factors underlying cost efficiency variation at the firm level. The first approach involves estimation of the stochastic frontier and the model for inefficiency effects in two separate stages (Kalirajan and Shand, 1985). The alternative approach involves the estimation of both stochastic cost frontier and the inefficiency effects in one stage (Battese and Coelli, 1993; Wang and Schmidt, 2002).

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[5] For more details on this process see Train (2002) and Greene (2002).

Given the complexity of the random parameters model, model convergence is a major problem when estimating both cost frontier and the inefficiency effects simultaneously in one stage. Thus, the present study adopts the two-stage approach to explore the impact of exogenous variables on cost efficiency. In addition, for the random parameters model, the normal–truncated normal model may not be identified (Greene, 2002b). To uncover the factors underlying inefficiency variation across firms, the second stage of the analysis investigates the impact of salient covariates on cost (in)efficiency using a random parameters Tobit regression. The general latent structure of the Tobit model is defined as:

$$CE_{ft}^* = \delta' z_{ft} + \varepsilon_{ft}, \quad N[0, \sigma^2] \qquad (4\text{-}10)$$

with the observed variable defined as:

if $CE_{ft}^* \le L_{ft}$, then $CE_{ft} = L_{ft}$ (lower tail censoring)

if $CE_{ft}^* \le U_{ft}$, then $CE_{ft} = U_{ft}$ (upper censoring)

if $L_{ft} \le CE_{ft}^* \le U_{ft}$, then $CE_{ft} = \delta' z_{ft} + \varepsilon_{ft}$

where CE_{ft} is observed cost efficiency for the f-th firm during the t-th time period; CE_{ft}^* is the latent cost efficiency; δ's are parameters to be estimated, z_{ft}'s are exogenous variables (i.e., debt leverage and firm size), and ε_{ft} is an i.i.d random error. The structure of the random parameters Tobit model is based on the following conditional density:

$$f(CE_{ft} \mid z_{ft}; \delta_f) = f(\delta_f' z_{ft}), \quad f = 1,\dots,N\ [=\text{firm}],\ t = 1,\dots,T\ [=\text{time}]. \qquad (4\text{-}11)$$

where $f(.)$ is the hybrid continuous/discrete density for the Tobit model. The parameter heterogeneity is defined as:

$$\delta_f = \delta + \xi_\delta d_f + \Gamma_\delta \upsilon_f \qquad (4\text{-}12)$$

where δ_f is a randomly distributed parameter to be estimated; δ is the unconditional mean of the distribution; ξ_δ is a set of parameters to be estimated; Γ_δ is a matrix that produces the covariance matrix of the random parameters; d_f are variables related to the distribution of the random parameters; υ is a random vector that affects the distribution of the parameters. The model assumes that parameters are randomly distributed with possibly heterogeneous (across firms) mean:

$$E[\delta_f \mid z_f] = \delta + \xi_\delta d_f \text{ and } Var[\delta_f \mid z_f] = \Sigma \qquad (4\text{-}13)$$

The heterogeneity term $\xi_\delta d_f$ is optional and some of the parameters may be non-random. The above random parameters Tobit model is estimated using a simulated maximum likelihood estimator. The independent variables used in this study are debt to asset ratio and sales. Debt to asset ratio is used as a proxy for managerial financial risk aversion, and sales are used to control for firm size. The hypothesized factors affecting cost efficiency are discussed below.

In this study some concerns with the two-stage procedure described above are acknowledged. First, the standard ordinary least square results in the second-stage may not be appropriate since the dependent variable (i.e., cost inefficiency) is one sided. The Tobit regression model may remedy this problem. Secondly, whereas in the first-stage the inefficiency effects are assumed to be independently and identically distributed, in the second-stage the predicted values of inefficiency are assumed to be a function of a number of firm-specific factors. This implies that they are not identically distributed (Battese and Coelli, 1993; Kumbhakar and Lovell, 2000) unless all the coefficients of the factors are simultaneously equal to zero (Coelli et al., 1998). Kumbhakar at al. (1991) state that the residual term in the second-stage regression does not have a clear meaning. Hence, the estimated coefficients and the corresponding standard error of the second stage analysis must be interpreted cautiously.

For the inefficiency effects two exogenous variables are included: firm size and debt leverage. One of the problems that merits scrutiny is the impact of financial leverage on cost inefficiency. No previous study has attempted to introduce the impact of debt leverage on the efficiency and productivity analysis for co-operative firms in Canada. Based on empirical and theoretical principal agent and signalling literature, leverage may have either positive or negative effects on cost efficiency

Finally, to control for variation in size, volume of sales is used. Agribusiness co-operatives that are operating at an inappropriate size (either too large or too small) may exhibit scale inefficiencies.

4.5 Data Description

The costs of production, wages and salaries, number of full-time and part-time employees, volume of sales, cost of goods sold, long-term debt, number of members, assets, liabilities and other financial data are obtained from the annual surveys of agribusiness co-operatives conducted by the Canadian Co-operative Secretariat (CCS), Government of Canada. The data are collected from non-financial co-operatives reporting to the Canadian Annual Survey of Co-operatives. Of approximately 1300 total agriculture-based co-operatives, approximately 900 reported to the Canadian Co-operative Secretariat in 2001. The agricultural marketing and supply co-operatives represent between 450-550 reporting co-operatives. This study focuses on those marketing and supply co-operatives from Alberta, Saskatchewan, Manitoba, British Columbia, Ontario and Quebec.

Data for the GDP deflator, fixed investment deflator, interest rate, raw material price indices and farm input price indices are gathered from Statistics Canada (CANSIM) for the period 1984-2001. The CCS survey data include information for a number of different types of co-operatives, including supply co-operatives (i.e., farm supply, feed mill, farm petroleum) and marketing co-operatives (i.e., dairy, fruit, vegetable, grain and oilseeds, poultry, poultry and eggs, honey and maple). Different regulatory structures are also reflected in the data (e.g., supply managed co-operatives handling dairy, poultry and eggs).

Agricultural marketing co-operatives are involved in processing and value added activities. In 2001, 165 marketing co-operatives reporting to the Canadian Co-operative Secretariat represented a combined business volume of more than $14.3 billion and assets of $5.4 billion. In 2001, they marketed over $10.7 billion in agricultural products in Canada and abroad. In 2001, in terms of market share, co-operatives marketing poultry and eggs, grains and oilseeds, and dairy represented more than 45 per cent in each market.

Conversely, farm supply co-operatives provide farm inputs to their members. They provide member co-operatives and producers with a broad range of farm inputs including fertilizers and chemicals, animal feed, seed, building materials and petroleum products. In 2001, approximately 240 supply co-operatives reported to the Canadian Co-operative Secretariat, contributing total revenues of $3.6 billion, up 8.3 per cent from 2000. In terms of market share, in farm supply the strongest areas are fertilizers and chemicals with 41 per cent, petroleum with 32 per cent and feed supplies with 15 per cent (Canadian Co-operative Secretariat, 2003).

Raw material /Farm Input Prices (M)[6]: Raw materials/farm inputs are treated as an aggregate input, excluding capital and labour which are dealt with separately. Raw material price indices and farm input price indices are collected from CANSIM. Cost of goods sold is used as a proxy for raw materials.

Capital Price (K): According to the opportunity cost principle, the unit cost of capital for a firm should be calculated as the rental value of the capital stock, as if the capital were being rented. The capital input group is an aggregate of land and buildings, machinery and equipment. Using the GDP Deflator and fixed capital price index, the relative price of one unit of capital with respect to production q, is calculated for Canada for each year[7]. In this study, per unit user cost of capital (r_k) is calculated as $r_k = (i - \pi + \delta) * q$, where i is the opportunity cost of capital, δ is the capital depreciation rate, q is the acquisition of capital and π is the rate of inflation in the economy.

Price of Labour (L): The labour input consists of full time and part-time labour. Both the number of employees and total salary and wages are available from the sample data, but with a high incidence of measurement error. The per hour wage rate is calculated assuming 40 working hours per week. Where there are outliers, the data are truncated at $25 per hour from above and $10 per hour from below based on aggregate wage information from Statistics Canada.

Output (y): The output variable represents value added (sales minus cost of goods sold). One of the challenges in estimating cost frontiers for supply and marketing co-operatives is that the direct measure of output (i.e., marketing services for marketing co-operatives and retailing services for supply co-operatives), y, is difficult if not impossible to quantify accurately. So value added is used as a proxy for y.

Total Cost (C): The total cost represents the sum of expenses for materials, labour, and capital for the firm. Prior to estimation, value added and all price indexes are normalized to one at the mean of the pooled sample.

Debt to asset ratio (D/A): Debt to asset ratio is used as a measure of the degree of financial leverage.

Volume of Sales: Volume of sales is used as a proxy for co-operative size. Other firm size indicators used in the literature include dollar value of assets and number of employees.

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[6] These are raw materials for marketing/processing co-operatives and farm inputs for farm supply co-operatives.

[7] Boadway (1985), proposed the following formula to calculate the service cost of capital:

$$r_k = q\left(\frac{i+\delta-r_q-\pi}{1-\pi}\right).\left(1-\phi\right).\left(1-\frac{\tau\alpha}{i+\alpha}\right).$$

where i is the opportunity cost of capital, δ is the capital depreciation rate, r_q is the rate of growth in the acquisition of capital q, π is the rate of inflation in the economy, τ is the corporate income tax rate, ϕ is the investment tax credit, and α is the percentage capital cost allowance (CCA) rate (per cent).

4.6 Results and Discussion

4.6.1 Descriptive Statistics

Table 4-1 provides descriptive statistics for the unbalanced sample of agricultural supply and marketing co-operatives by activity over the period 1984-2001. Dairy, oilseeds and grains and poultry and eggs marketing co-operatives are characterized by higher total assets, sales and value added, and larger numbers of employees and members, suggesting that marketing co-operatives tend to be bigger than supply co-operatives. A closer look at financial ratios indicates that marketing co-operatives are characterized by lower levels of profitability as measured by ROA and a higher degree of financial leverage as measured by debt to asset ratio. From this observation it can be hypothesized that there is a negative relationship between profitability and financial risk exposure for the sample co-operatives. For the overall sample of co-operative agribusiness firms, the estimated correlation between profitability and leverage is negative ($\rho = -0.311$).

4.6.2 Model Results

The stochastic frontier models in this study are estimated using a maximum simulated likelihood routine in LIMDEP (NLOGIT 3.0.1/14). To address the problem of determining the best model to estimate firm level cost (in)efficiency, formal model selection criteria and theoretical information based on the nature of data are used. A statistical test is conducted to show if the observed technological differences matter in the estimation of frontier cost functions. For example, given the heterogeneity among the sample firms in terms of observed technological differences across firms in different industries, estimation of separate frontiers for each industry may be appropriate. From a theoretical as well as a practical point of view, estimating the same cost frontier for firms in different industries as if they use the same technology does not make any economic sense. For example, firms from dairy co-operatives and grain co-operatives have completely different technologies. In addition, these industries operate under different regulatory structures. Thus, it is imperative to estimate a separate frontier for each industry. However, to support this economic intuition, statistical tests are conducted to see whether or not the firms from different industries should be aggregated into one group. In the following sections, various model tests are conducted. To account for the unobserved technological differences among co-operative firms in the same industry, the random parameters stochastic frontier model is used.

4.6.2.1 Observed Heterogeneity in Technology

Formal statistical tests are conducted to investigate whether or not to estimate a single frontier for the co-operative sector as a whole or to estimate a separate frontier for each industry. To do so, models with (i.e., $\beta_{fi} = \beta + \xi_\beta \mathrm{dairy}_f + \xi_\beta \mathrm{grains}_f + \xi_\beta \mathrm{fruits}_f + \xi_\beta \mathrm{honey}_f + \Gamma_\beta m_{\beta_f}$) and without (i.e., $\beta_{fi} = \beta + \Gamma_\beta m_{\beta_f}$) heterogeneity in mean are estimated and compared using a likelihood ratio test. The log-likelihood function values for the models with and without heterogeneity in the mean of the random parameters are -663.487 and -727.596, respectively. The calculated chi-square value is 68.218 whereas the critical chi-square value is 67.505, for 50 degrees of freedom at the 95 per cent confidence level. Consistent with the intuitive claim, this result suggests that there is a real difference in technologies between firms in different industries. Thus, pooling firms from different industries into a single frontier analysis is inappropriate. Based on these results, four frontiers for marketing co-operatives (i.e., one for dairy, one for grains, one for fruit and vegetable, and one for honey and maple) and three frontiers for agricultural supply co-operatives (i.e., one for farm supply, one for feed mill, and one for farm petroleum) are estimated separately.

4.6.2.2 Unobserved Heterogeneity in Technology

In this section, a comparison of the random parameters model (heterogeneous technology model) and the random effects frontier model (homogeneous technology model) is made based on statistical tests. Model selection between the homogenous (i.e., random effects) technology frontiers and heterogeneous technology frontiers is done for selected agricultural marketing co-operatives. Since the two models are non-nested in each other, appropriate (i.e., non-nested) model selection tests are used. The Akaike Information Criterion (AIC) and Bayes Information Criterion (BIC) are used to select the best model.

Based on these criteria, the best model is the one with the lowest AIC/BIC value. Table 4-2 presents the Log-likelihood function (LLF), AIC, and BIC values and the corresponding means and standard deviations of cost efficiency scores. Based on the AIC and BIC values, the random parameters model best fits the sample data. Thus, random parameters models are considered for further analysis of the cost frontier and cost efficiency measurements. The superiority of the heterogeneous technology model is consistent with the findings of Tsionas (2002; 2002a), Caudill (2003), Orea and Kumbhakar (2004), among others.

The differences in estimated cost efficiency are also presented in the bottom two rows of Table 4-2. The results suggest that cost efficiency scores differ among the estimated models, and are higher for the random parameters model implying that efficiency scores are higher under the assumption of heterogeneous technology. Thus, the unobserved technological heterogeneity matters in the estimation of cost efficiency suggesting that part of estimated cost inefficiencies may be unobserved technological differences. These results are consistent with what has been obtained in previous studies using heterogeneous technology models (e.g.,Tsionas, 2002; Orea and Kumbhakar, 2004; Huang, 2004). For example, Huang found that the posterior means of efficiency measures were higher for a random parameters model (i.e., 99.5 per cent) than those obtained for the fixed parameters case (i.e., 67.1 per cent).

To take into account the observed heterogeneity across firms in different industries, a separate cost frontier is estimated for each industry. At the same time, to account for unobserved technological differences across firms in the same industry, the random parameters stochastic frontier is implemented. The cost structures and the cost efficiencies of i) dairy co-operatives; ii) grain and oilseed co-operatives; iii) fruit and vegetable co-operatives; iv) honey and maple co-operatives v) farm supply co-operatives; vi) feed mill co-operatives and; vii) farm petroleum co-operatives, over the period 1984-2001, are explored and presented individually using the random parameters stochastic frontier model. Since the data on industry level time invariant variables (e.g., location) are not available the random parameters model without heterogeneity in means (i.e., $\beta_{fi} = \beta + \Gamma_{\beta} m_{\beta_f}$) is estimated for each industry.

4.6.2.3 Dairy and Grains Marketing Co-operatives

Two separate random parameters stochastic cost frontiers are estimated for dairy and grains marketing co-operatives. In this section, the cost structures and cost efficiencies are presented and discussed individually for each other these frontiers.

4.6.2.3.1 Parameter Estimates for Dairy and Grains Co-operatives

As stated earlier, to allow for unobserved heterogeneity across firms, random parameters stochastic frontier models are used to measure firm efficiency of 28 dairy and 14 grain marketing co-operatives over the period 1984-2001. The simulated maximum log-likelihood parameter estimates for dairy and grains co-operatives' stochastic frontier models, with a half-normal distributional assumption, are given in Table 4-3.

The results in Table 4-3 are based on 100 draws of the Halton sequence simulation. With the exception of the coefficient for the time variable, σ_u, σ_v, σ, and λ, all other parameters are random. Estimation of a cost function assumes certain regularity conditions: homogeneity, symmetry, monotonicity and concavity. For both dairy and grain models, homogeneity in input prices and symmetry are imposed prior to estimation. Monotonicity is checked at the mean value of the estimated input cost shares. At the mean value, material, labour and capital cost shares are all greater than zero suggesting that on average the data fulfil the monotonicity condition. Concavity of the cost function is checked by evaluating the negative semi-definiteness of the Hessian matrix at the mean value. The partial elasticities of substitution are calculated as: $\sigma_{ii} = \left(\beta_{ii} + S_{it}^2 - S_{it}\right)/S_{it}^2$, i= i-th input; and $\sigma_{ij} = \left(\beta_{ij} + S_{it} S_{jt}\right)/S_{it} S_{jt}$, i,j= i-th, j-th input (i≠j) (Table 4-4). All eigenvalues should be less than or equal to zero for the concavity condition to be fulfilled. For the grain model, all the eigenvalues are less than zero indicating that the curvature condition is satisfied at the mean value of the data. For the dairy model, one of the eigenvalues is greater than zero suggesting a violation of the concavity condition.

As well, Table 4-4 shows the own and cross input price elasticities for the random parameters stochastic cost frontiers. The own price elasticities of demand for the i-th input are calculated as: $\varepsilon_{ii} = \sigma_{ii} S_{it}$. The cross price elasticity of demand for the i-th input with respect to the j-th input price is calculated as: $\varepsilon_{ij} = \sigma_{ij} S_{it}$. For the dairy co-operative model, the results suggest that capital is complementary to both material and labour, whereas material and labour are substitutes for each other. For the grain model, capital is a substitute for both material and labour, while material and labour are complementary. In passing it should be noted that though the mean (own) price elasticities have the expected negative signs, with the exception of capital in the dairy model, they are very large. This result is possibly due to multicollinearity or other unmodeled effects.

For the sample agribusiness co-operative firms, returns to scale (RS) are also calculated using the following equation: $RS_{ft} = 1/(\beta_y + \sum_j \beta_{iy} \ln w_{jft} + \beta_{yy} \ln y_{ft})$. Table 4-5 presents the means and standard deviations of returns to scale. The mean returns to scale are 1.909 and 1.412 for dairy and grain marketing co-operatives, respectively. This suggests that doubling all the inputs may increase output by more than double, or more output can be achieved at a lower cost. Variability in returns to scale is higher for dairy co-operatives than for grain co-operatives. In general, larger-sized dairy and grain co-operatives appear to be more cost-effective. For the U.S. farm supply and marketing co-operatives, Schroeder (1992) found the existence of economies of scale indicating that this may lead to fewer co-operatives in the industry. Thraen, Hahn and Roof (1987) also found that processing costs for fluid milk co-operatives decline with increased plant size. For grain co-operatives, Ariyarante et al. (1997) found that 81.3 per cent of the firms operated in the increasing returns to scale region.

4.6.2.3.2 Efficiency Measurements for Dairy and Grains Co-operatives

One of the objectives of this study is to explore the nature of cost efficiency among agricultural co-operatives in Canada. Once the frontier cost function is estimated the next step is to calculate individual firm level cost efficiencies. The maximum likelihood estimates for the λ-parameters are 1.970 and 1.962 for dairy and grain, respectively (Table 4-4). These are statistically significant at a 95 per cent confidence level indicating that there is significant inter-firm cost efficiency variability in each industry. Given the estimates of σ_u and σ_v, approximately 80 per cent and 79 per cent of the variability in the stochastic frontier models for dairy and grain (respectively) is due to their cost inefficiency components[8]. Summary statistics for the cost efficiency estimates based on the random parameters stochastic frontier model are given in Table 4-6.

Based on the random parameters stochastic frontier model estimates, the cost efficiency of dairy marketing co-operatives ranges between 30.9 per cent and 94.6 per cent with a mean of 74.6 per cent. For grain marketing co-operatives, the cost efficiency ranges between 48.8 per cent and 96.5 per cent with a mean of 83.9 per cent. There is more variability in cost efficiency among firms in the dairy industry (0.120) than among firms in the grains industry (0.085) (Table 4-6).

4.6.2.3.3 Inefficiency Effects for Dairy and Grain Co-operatives

A summary of average dairy marketing co-operatives sample observation characteristics by efficiency category is provided in Table 4-7. In general, for the majority of large dairy co-operative sample observations, the efficiency scores range between 70 per cent and 80 per cent. Based on descriptive statistics, there is no obvious relationship between small size dairy co-operative sample observations and their efficiency scores. Some of the small dairy co-operative sample observations are found to be the least efficient while others are the most efficient. Dairy co-operative sample observations with lower reliance on debt (i.e., lower debt to assets ratio) appear to be more cost efficient as compared to those with higher debt financing. This result may suggest that dairy co-operative sample observations with higher leverage are less cost competitive.

Table 4-8 presents descriptive statistics for individual firms in the dairy industry. Correlation coefficient is calculated for each firm to descriptively examine the relationship between firm efficiency and firm size, as well as firm efficiency and the degree of financial leverage over the sample period (i.e., 1984-2001). Results indicate that for 36 (64) per cent and 32 (68) per cent of the firms in the dairy industry their efficiency score is positively (negatively) correlated with firm size and financial leverage, respectively. These results suggest that for the majority of the co-operatives in the dairy industry, efficiency plummets as firm size and financial leverage grow. Table 4-8 provides descriptive statistics for individual dairy firms over the period 1984-2001. Over the 18 year period, average efficiency for individual firms' ranges between 0.604 and 0.827. The minimum efficiency for individual firm ranges between 0.309 and 0.779. The maximum efficiency ranges between 0.754 and 0.946. The correlation between the firms' mean efficiency and the firms' mean size is calculated to be 0.134, while the correlation between firms' mean efficiency and firms' mean financial leverage ratio is -0.105.

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[8] These percentages are calculated using the formula: $\left(\dfrac{\sigma_u^2}{\sigma_u^2+\sigma_v^2}\right)\text{x}100$.

presents the relationship between average sample observation characteristics and their efficiency for grain marketing co-operatives. Grain co-operative sample observations with large sales volume and large asset values tend to be less efficient. Consistent with results for dairy co-operative sample observations, grain co-operative sample observations with low debt financing and high return to assets tend to be more efficient. Again, the fact that debt financing has a negative "relationship" with efficiency may suggest that efficiency decreases with increases in the degree of financial leverage.

Table 4-10 presents descriptive statistics for individual co-operative in the grain industry. The results for co-operatives in the grain industry indicate that for 36 (64) per cent of the firms, the correlation coefficient between individual firm efficiency and firm size over the study period is greater (lower) than zero, so it appears that these firms exhibit higher (lower) efficiency as they grow in size. Over the same period, the correlation coefficient between firm efficiency and the degree of financial leverage for 27 (73) per cent of grain co-operatives is greater (lower) than zero. This suggests that the efficiency of 27 (73) per cent of the grain co-operatives increases (decreases) as the financial leverage increases (decreases). For co-operatives in the grain industry, summary of individual firm average, minimum and maximum efficiencies is provided in Table 4-10. Individual firms' average efficiency ranges between 0.799 and 0.875 while the minimum and maximum efficiencies range, respectively, between 0.488 and 0.862, and 0.862 and 0.965. The correlation coefficient between the firms' average efficiency and the firm size is -0.546 while the correlation coefficient between the firms' average efficiency and leverage ratio is -0.388.

Given the descriptive relationship between efficiency scores and financial leverage and firm size, the next step is to rigorously (i.e., statistically) investigate which factors are related to efficiency differences across firms. Table 4-11 provides the random parameters Tobit regression parameter estimates for the determinants of cost efficiency for dairy and grain marketing co-operatives. The results indicate that firm size, as measured by the volume of sales, is quadratically and significantly related to cost efficiency of dairy co-operatives. This suggests that, initially, cost efficiency increases with size, reaches a maximum and eventually starts decreasing. Accordingly, there may be an optimum firm size at which cost efficiency reaches a maximum for the dairy marketing co-operatives[9].

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[9] According to Coase (1937) as a firm grows larger its costs for achieving particular arrangements managerially tend to rise. The larger the firm, the more complex and hence expensive its management becomes, until further growth would make the cost of managing the newly internalized operations higher

Technological theories emphasize physical capital and economies of scale and scope as factors that determine optimal firm size and, by implication, efficiency (Kumar et al., 2002). These theories focus on the production process and the investment in physical capital necessary to produce output. Increasing economies of scale that permit fixed costs to be spread over large output volumes, thereby decreasing the average cost of production are associated with increases in firm size. If economies of scale cease to exist, at that point bigger is no longer better, at least in terms of lowering production costs and improving efficiency. Organizational theories of the firm grounded in transaction costs (Williamson, 1985), agency costs (Jensen and Meckling, 1976) and span of control costs also predict that at some point average per unit transaction and agency costs would increase and offset economies of scale and scope thus establishing an optimal size for the firm in terms of efficiency or profitability.

The basic implication of technological and organizational theories emphasizing transaction and agency costs of firm size is that within a specific industry (common production technology) and within a common institutional environment, firm size and efficiency may be linked through a trade-off of economies of scale and transactions costs and agency costs.

For grain marketing co-operatives, although the relationship between cost efficiency and firm size is similar to that of the dairy industry, it is not statistically significant[10]. Debt to asset ratio is significantly and negatively related to cost efficiency of both dairy and grain marketing co-operatives. This result is consistent with values in Table 4-7 and Table 4-9. This suggests that for the dairy and grain co-operatives, cost efficiency decreases as the degree of financial risk increases. This result is also consistent with agency theory that states that agency costs due to conflicts of interests increase with the level of debt (Jensen and Meckling 1976).

In terms of marginal effects, the explanatory variables have a stronger effect for the dairy co-operatives model as compared to the grain co-operatives model. This may suggest that the financial leverage effect is more important for dairy co-operatives. This is consistent with financial leverage impact studies that firms may be operating at various levels of cost inefficiency due to differences in capital structures (Nasr et al., 1998; Rajan and Zingales, 1995; Johnson, 1997; Michaelas et al., 1999). From the above, a substantial number of dairy and grain marketing co-operatives could be more efficient by adjusting their size and capital structure.

4.6.2.4 Fruit and Vegetable Marketing Co-operatives

In this section, the cost efficiency for an unbalanced sample of 54 fruit and vegetable co-operatives over the period 1984-2001 is explored using a random parameters stochastic frontier. Since there are two major types of products that are handled by the fruit and vegetable co-operatives (and the data for these attributes are also available), two separate random parameters models are estimated and tested: with (i.e., $\beta_{fi} = \beta + \xi_\beta \text{fruit}_f + \Gamma_\beta m_{\beta_f}$, fruit = 1, for fruit co-operatives; fruit=0, for vegetables

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than the cost of transacting them on the market. Firms grow until conversion of further transaction costs into internal organizational costs ceases to represent a net saving.

[10] Standard significance tests of structural parameters in random parameter models do not necessarily indicate the presence or absence of a 'significant' relationship among the model variables (Greene, 2004).

co-operative) and without (i.e., $\beta_{fi} = \beta + \Gamma_{\beta} m_{\beta_f}$) heterogeneity in the means of the random parameters. A Likelihood ratio test is conducted to select the best model (Table 4-12). At a 90 per cent confidence level, the random parameters model without heterogeneous means is rejected in favour of the random parameters model with heterogeneity in the means. Thus, the following results for fruit and vegetable co-operatives are based on the estimates for the random parameters model with heterogeneous means.

4.6.2.4.1 Parameter Estimates for Fruit and Vegetable Co-operatives

A single cost frontier is estimated for both fruit and vegetable co-operatives. The simulated maximum likelihood parameter estimates for the fruit and vegetable co-operatives cost frontier are provided in Table 4-13. Before estimating the cost efficiency scores, the regularity conditions for the cost function are checked. Linear homogeneity and symmetry in input prices are imposed prior to estimation. Monotonicity and concavity are checked and both are satisfied at the mean value.

Before turning to an investigation of cost efficiency, the estimated cost frontier structure is explored. Table 4-14 reports input substitution elasticities and input price elasticities. For the fruit and vegetable co-operatives, the own-price elasticity of labour is larger that the own-price elasticities of material and capital; all three inputs are substitutes for each other.

Table 4-15 provides the estimated returns to scale for the sample fruit and vegetable co-operatives. Based on the mean value of the returns to scale it can be seen that both fruit and vegetable co-operatives are operating in the region of increasing returns to scale. This may suggest that larger-sized fruit and vegetable co-operatives are more cost effective. This is similar to the results found earlier for dairy and grain marketing co-operatives.

4.6.2.4.2 Efficiency Measurements for Fruit and Vegetable Co-operatives

In the estimation of a stochastic frontier the variance parameters are important since they indicate the relative importance of inefficiency and random effects. Given the estimates of σ_u and σ_v, the results suggest that 81 per cent of the deviation from the frontier is attributable to cost inefficiency. In addition, the fact that λ is statistically significant suggests the existence of cost inefficiency for the sample co-operatives. Table 4-16 reports the average cost efficiency for the fruit and vegetable co-operatives. The results show that the mean cost efficiency of the 54 fruit and vegetable marketing co-operatives over the period 1984-2001 is estimated to be 72.0 per cent (Table 4-16). This level of cost efficiency is relatively lower than that for dairy and grain marketing co-operatives. This suggests that there is more variability in terms of efficiency across firms in the fruit and vegetable marketing co-operatives as compared to the grain co-operatives. There is not much difference in the degree of variation in efficiency between dairy and fruit and vegetable co-operatives.

4.6.2.4.3 Inefficiency Effects for Fruit and Vegetable Co-operatives

Table 4-17 presents the relationship between average sample observations characteristics and their efficiency for fruit and vegetable marketing co-operatives. For fruit and vegetable co-operatives, sample observations with large sales values are characterized by lower efficiency. However, there is no definite relationship between asset values and efficiency for fruit and vegetable co-operative sample observations. As well, the relationship between leverage and efficiency is ambiguous. In general, observations with higher return on assets appear to be more efficient as compared to those with lower returns. Sample observations with larger numbers of employees are more efficient.

Table 4-18 presents descriptive statistics for individual fruit and vegetable co-operative. For 20 (80) per cent of fruit and vegetable co-operatives, individual firm efficiency and firm size are positively (negatively) correlated over the sample period. This indicates that the efficiency of 20 per cent of fruit and vegetable co-operatives increases with firm size whereas the efficiency of 80 per cent of fruit and vegetable co-operatives decreases with firm size. For 39 per cent of fruit and vegetable co-operatives, their efficiency and financial leverage are correlated positively, suggesting that their efficiency increases with the financial leverage. On the other hand, for 61 per cent of fruit and vegetable co-operatives, efficiency and the degree of financial leverage are negatively correlated, suggesting that firm efficiency decreases with the degree of financial leverage. For fruit and vegetable co-operatives, a summary of individual firms' average, minimum and maximum efficiencies over the study period is provided in Table 4-18. Firms' average efficiency ranges between 0.615 and 0.772 while firms' minimum and maximum efficiency ranges, respectively, between 0.032 and 0.680, and 0.756 and 0.959. The correlation between firms' average efficiency and firm size is 0.023 while the correlation between the firms' average efficiency and leverage ratio is -0.02.

The Tobit regression random parameter estimates for factors affecting cost efficiency are given in Table 4-19. The results indicate that co-operative size is quadratically related to cost efficiency. This suggests that smaller-sized and larger-sized fruit and vegetable co-operatives are more cost efficient than medium-sized co-operatives. As discussed earlier, the basic implication of technological and organizational theories emphasizing transaction and agency costs of firm size is that within a specific industry (common production technology) and within a common institutional environment, firm size and efficiency may be linked through a trade-off of economies of scale and transactions costs and agency costs. In the case of fruit and vegetable co-operatives, transaction and agency costs of size may more than offset the benefits from economies of scale for medium-sized co-operatives as compared to their smaller and larger counterparts. This is particularly possible if the organization costs curve is concave from the above and if at the same time the vertical distance between the average costs of production and organizing costs is at its maximum at a medium firm size.

Financial leverage is found to have, on average, a negative impact on the cost efficiency of fruit and vegetable co-operatives which may suggest the likely negative impact of financial pressure on co-operative performance. This is consistent with the descriptive results presented in Table 4-17. This is also similar to the result found for dairy and grains marketing co-operatives. Yet, the marginal effects for size are higher for fruit and vegetable as compared to either dairy or grain co-operatives. This may suggest that, on average, the economic significance of size is greater for fruit and vegetable co-operatives. Other things being equal, fruit and vegetable co-operatives are more likely to reduce costs by focusing on size adjustment. On the other hand, the degree of economic significance of leverage is higher for dairy co-operatives.

4.6.2.5 Honey and Maple Marketing Co-operatives

In this section, the cost efficiency measures for five honey and maple co-operatives over the period 1984-2001 are presented and discussed. Relative to the other types of co-operatives considered in this analysis, the sample size for honey and maple marketing co-operatives is small. When sample size is small, estimation of more flexible functional forms may be a problem. Among the problems in the estimation of the Translog cost function when the sample size is very small are micronumerosity, which arises when the number of observations barely exceeds the number of parameters to be estimated (Gujarati, 1995), and multicollinearity problems. According to Larue et al. (2002 ii)

> *Monte Carlo simulations results indicated that the Cobb-Douglas functional form performs as well as or better than the Translog and the Generalized Leontief functional forms for most data generating processes, especially for small sample sizes.*

From their findings Larue et al. (2002) concluded that the Cobb-Douglas was not dominated in small and medium-size samples. Thus, the Cobb-Douglas functional form is used for the purpose of estimating cost efficiency for honey and maple marketing co-operatives. It should be noted, however, that dominance of one functional form over another may be data specific.

4.6.2.5.1 Parameter Estimates for Honey and Maple Co-operatives

Table 4-20 provides the parameter estimates for the random parameters Cobb-Douglas stochastic cost frontier for honey and maple marketing co-operatives. The homogeneity condition is imposed prior to estimation. All of the posterior means of the Cobb-Douglas stochastic cost frontier are statistically significant at the 5 per cent level.

4.6.2.5.2 Efficiency Measurements for Honey and Maple Co-operatives

The variance estimates for the stochastic cost frontier functions indicate that approximately 75 per cent of the deviations from the frontier are due to cost inefficiency. In addition, the fact that the λ parameters are statistically significant suggests the existence of cost inefficiency. The results show that the mean cost efficiency of the five honey and maple marketing co-operatives over the period 1984-2001 is estimated to be 85.33 per cent with a standard deviation of 0.073. This result suggests that costs could have been reduced by approximately 15 per cent, on average, in order to produce the same level of output without increases in input usage had firms been operating at their frontiers.

4.6.2.5.3 Inefficiency Effects for Honey and Maple Co-operatives

Table 4-21 depicts the relationship between the average sample observation characteristics and efficiency levels for honey and maple co-operatives. Sample observations with larger volume of sales, larger asset values, large number of employees and large number of members appear to be less efficient. Descriptive statistics results indicate that honey and maple co-operative sample observations with higher debt financing are less efficient, which is consistent with results for dairy and grain marketing co-operatives.

For honey and maple co-operatives, a summary of individual firm average, minimum and maximum efficiency (over the period 1984-2001) is provided in Table 4-22. Individual firms' average efficiency ranges between 0.844 and 0.884 while individual firms' minimum and maximum efficiencies ranges, respectively, between 0.637 and 0.884, and 0.874 and 0.958. Correlation between firms' average efficiency and firm size is -0.745 while the correlation between the firms' average efficiency and leverage ratio is 0.045.

The random parameters Tobit regression estimates for factors affecting cost efficiency are provided in Table 4-23. On average, the results indicate that co-operative size does not have a statistically significant effect on cost efficiencies for honey and maple marketing co-operatives. In terms of the relationship (i.e., the sign), a similar quadratic relationship is found for dairy marketing co-operatives as well. Financial leverage is found to have, on average, a negative impact on the cost efficiency of fruit and vegetable co-operatives which may suggest a possible negative impact of capital constraints on co-operative performance. As compared to both dairy and fruit and vegetable co-operative, the marginal effect for leverage is larger for honey co-operatives. This may suggest that the impact of negative leverage on efficiency may be higher for honey co-operatives than for other types of marketing co-operatives.

4.6.2.6 Agricultural Supply Co-operatives

In this section, the cost structure and cost efficiency for an unbalanced sample of 250 agricultural supply co-operatives (i.e., 93 farm supply, 42 feed mill and 115 farm petroleum co-operatives) over the period 1984-2001 is investigated using a random parameters stochastic frontier model. Factors affecting cost efficiency are also investigated.

4.6.2.6.1 Parameter Estimates for Supply Co-operatives

For agricultural supply co-operatives, three separate random parameters cost frontiers are estimated: one each for farm supply, feed mills and farm petroleum co-operatives. The simulated maximum likelihood estimates of the random parameters stochastic frontiers are provided in Table 4-24. The simulation is conducted using 150 draws of the Halton sequence. Most of the parameter estimates are statistically significant at the 5 per cent significance level. With respect to regularity conditions of the cost function, the homogeneity and symmetry conditions are imposed prior to estimation on the cost function. The concavity and monotonicity conditions are checked after estimation at the mean value. The estimated share values for material, labour and capital at the mean values are greater than zero suggesting that, on average, the data satisfy the monotonicity condition in input prices for the three types of co-operatives. For feed mill and farm petroleum co-operatives models all the three eigenvalues are negative suggesting that concavity conditions are satisfied at the mean value. For the farm supply co-operatives model, only one of the eigenvalues is positive (i.e., labour) implying violation of concavity condition. This violation could be due to the quality of data used, model specification error, or some other unmodeled effects.

Table 4-25 shows input substitution elasticities and input price elasticities for farm supply, feed mill, and farm petroleum co-operatives. With the exception of capital in the farm supply model, all own-substitution elasticities have the expected negative signs. For farm supply co-operatives, labour and material are substitutes, whereas capital is complementary to both labour and material. For feed mill and farm petroleum co-operatives, capital is a substitute for both material and labour, but labour and material are complements.

The calculated own and cross input price elasticities of demand are given in Table 4-26. All own price elasticities for sample feed mill and farm petroleum co-operatives have the expected negative signs. For both feed mill and petroleum co-operatives, material and labour are complements, while capital is a substitute for material and labour. For farm supply co-operatives, only labour own input price elasticity has the expected negative sign.

Returns to scale are also calculated for the three models (i.e., farm supply, feed mill and petroleum co-operatives) and all of them are operating in the region of increasing returns to scale (Table 4-26). For farm supply, feed mill and farm petroleum co-operatives, the mean returns to scale are 1.480, 1.761 and 12.027, respectively. On average, these results suggest that larger-sized supply co-operatives are more cost-effective. The presence of increasing returns to scale is consistent with the findings for marketing co-operatives.

4.6.2.6.2 Efficiency Measurements for Supply Co-operatives

The cost efficiency estimates for the three agricultural supply co-operative models are shown in Table 4-27. From the composed error variance parameter estimates in Table 4-20 (i.e., λ), it can be seen that there are statistically significant cost inefficiencies for supply co-operatives. The results indicate that 54 per cent, 35 per cent and 62 per cent of the deviations of the actual costs from the frontier costs are due to cost inefficiency for farm supply, feed mill and petroleum co-operatives, respectively. Using the parameter estimates from the cost frontiers, the cost efficiency is calculated for each firm. Table 4-27 provides summary statistics for these efficiency scores. For farm supply co-operatives, the average cost efficiency is 77.8 per cent with a standard deviation of 0.168. The cost efficiency for feed mill co-operatives ranges between 46.3 per cent and 99.1 per cent with an average of 85.4 per cent suggesting that, on average, costs of production would have been reduced by about 15 percent had the co-operative been operating on the cost frontier. In terms of inter-firm efficiency variation within the sector, there is less variation among the firms operating in the feed mill industry (i.e., a coefficient of variation of 14 per cent) as compared to the firms operating in the farm petroleum industry (i.e., a coefficient of variation of 23 percent). In addition, a high average efficiency level for feed mill and petroleum co-operatives may simply be indicative of a relatively homogeneous sample.

4.6.2.6.3 Inefficiency Effects for Supply Co-operatives

Table 4-28 presents the relationship between average sample observation characteristics and their efficiency for farm supply co-operatives. In general, farm supply co-operative sample observations with larger memberships and more employees appear to be less efficient. As compared to observations with smaller sales volume and asset values, observations with larger volume of sales tend to be less efficient. These results may suggest that larger sized farm supply co-operative observations are less efficient as compared to smaller sized observations. Consistent with the results for marketing co-operatives, farm supply co-operative sample observations with higher debt financing appear to be less efficient.

Table 4-29 presents the relationship between average sample observation characteristics and their efficiency categories for feed mill co-operatives. For feed mill co-operative, larger sample observations tend to be less efficient. Sample observations with higher debt financing and lower returns on assets are characterized by lower efficiency. As in the case for farm supply co-operatives, feed co-operative sample observations with larger membership are characterized by lower efficiency.

The relationship between average sample observation characteristics and firm efficiency for farm petroleum co-operative sample observations is presented in Table 4-30. Results suggest that sample observations with larger sales volume, larger asset values, larger membership and more employees are characterized by lower efficiency. However, observations with lower returns on assets are characterized by high efficiency. Farm petroleum sample observations with higher debt financing appear to be less efficient.

Table 4-31 presents descriptive statistics for individual farm supply co-operative. Correlation coefficient is calculated for each firm in supply co-operative sector to descriptively examine the relationship between their efficiency and size, as well as firm efficiency and financial leverage over the sample period (i.e., 1984-2001). For 18 (82) per cent of farm supply co-operatives, the correlation coefficient between the efficiency of individual firm and sales volume over the study period is greater (lower) than zero, so it appears that these firms exhibit higher (lower) efficiency as they grow in size. For 40 (60) per cent of farm supply co-operatives, the correlation coefficient between efficiency and financial leverage is greater (lower) than zero. This suggests that the efficiency of 27 (73) per cent of the farm supply co-operatives increases (decreases) as financial leverage increases (decreases). For farm supply co-operatives, a summary of individual firms' average, minimum and maximum efficiency (over the period 1984-2001) is provided in Table 4-31. The firms' average efficiency ranges between 0.206 and 0.986 whereas the firms' minimum and maximum efficiencies range, respectively, between 0.190 and 0.986, and 0.221 and 0.986. The correlation coefficient between the firms' average efficiency and firm size is -0.565 while the correlation coefficient between individual firms' average efficiency and leverage ratio is -0.488.

Table 4-31 presents descriptive statistics for individual farm petroleum co-operative. For 29 (71) per cent of farm petroleum co-operatives, the correlation coefficient between the efficiency of individual firm and their size over the study period is greater (lower) than zero, so it appears that these firms exhibit higher (lower) efficiency as they grow in size. For 38 (62) per cent of farm petroleum co-operatives, the correlation coefficient between efficiency and financial leverage is greater (lower) than zero. This suggests that the efficiency of 38 (62) per cent of farm petroleum co-operatives increases (decreases) as the financial leverage increases (decreases). For farm petroleum co-operatives, a summary of individual firms' average, minimum and maximum efficiency (over the period 1984-2001) is provided in Table 4-32. The firms' average efficiency ranges between 0.579 and 0.975 while firms' minimum and maximum efficiencies range, respectively, between 0.463 and 0.968, and 0.660 and 0.991. The correlation between firms' average efficiency and firm size is -0.887 while the correlation between the firms' average efficiency and leverage ratio is -0.412.

Table 4-31 presents descriptive statistics for individual feed mill co-operative. For 6 (94) per cent of feed mill co-operatives, individual firms' efficiency and their size are positively (negatively) correlated. This indicates that the efficiency of 6 per cent of feed mill co-operatives increases with firm size whereas the efficiency of 94 per cent of feed mill co-operatives decreases with firm size. For 50 per cent of feed mill co-operatives, their efficiency and financial leverage are positively correlated, suggesting that efficiency increases with financial leverage. For the remaining 50 per cent of feed mill co-operatives their efficiency and financial leverage are negatively correlated, suggesting that their firm efficiency decreases with financial leverage. A summary of firms' average, minimum and maximum efficiencies is provided in Table 4-33. The firms' average efficiency ranges between 0.017 and 0.985 while individual firm's minimum and maximum efficiencies range, respectively, between 0.011 and 0.985, and 0.026 and 0.987. The correlation coefficient between the firms' average efficiency and their size is -0.453 while the correlation coefficient between the firms' average efficiency and their financial leverage is -0.232.

Table 4-34 provides the Tobit regression random parameters model estimates for the determinants of cost efficiency for farm supply, feed mill and farm petroleum co-operatives. For the three agricultural supply co-operative models, firm size is quadratically and significantly related to cost efficiency, suggesting that cost efficiency declines initially, reaches a minimum, and starts increasing eventually. The fact that smaller co-operatives are more cost efficient is consistent with values in Table 4-28 to Table 4-30. Debt to asset ratio has a negative and statistically significant impact on the cost efficiency of farm supply and farm petroleum co-operatives, and a positive and statistically significant effect on the cost efficiency of feed mill co-operatives. The negative relationship between cost efficiency and leverage is consistent with figures in Table 4-28 and Table 4-29. Thus, higher financial leverage has contributed to lower (higher) cost efficiency for farm supply and farm petroleum (feed mill) co-operatives. In terms of marginal effects, the economic impact of leverage is more pronounced for farm supply co-operatives than for farm petroleum co-operatives. Although the optimal level may not be determined based on this study, reduction in the level of leverage may help reduce costs of production for farm supply and farm petroleum co-operatives. The results for feed mill co-operatives are consistent with the free cash flow hypothesis. When there are excessive cash flows in a co-operative firm, the free cash flow hypothesis or the control hypothesis (Jensen, 1986b) postulates that debt motivates managers to become more efficient.

4.6.2.7 Cost Efficiency and Profitability

Table 4-35 depicts correlation estimates between profitability and cost efficiency for selected agribusiness co-operatives. The magnitudes of the correlation coefficients suggest that there is relatively low correlation between cost efficiency and profitability for the sample co-operatives. The correlation coefficients are positive for all marketing co-operatives, whereas they are negative for all supply co-operatives. The findings for the supply co-operatives are unexpected. One possible explanation is that cost efficiency and revenue may be negatively related, so that firms with lower cost efficiency tend to have offsetting higher revenue efficiency. This could occur because firms with high revenue efficiency may feel less market discipline to control their costs (Berger and Mester, 1997). The finding for marketing co-operatives is consistent with the results from

Ariyaratne et al. (1997). For grain marketing and farm supply co-operatives in the U.S., Ariyaratne et al. (1997) found that return to assets and equity were positively correlated with technical and allocative efficiency and indicated that sub-optimal production technologies and sub-optimal input bundles were more important in determining financial health than was sub-optimal scale. For example, an increase in technical efficiency of 0.1 would have increased ROA by 0.4 per cent, and ROA would have increased by 0.5 per cent for a unit change in the allocative efficiency measure (Ariyaratne et al., 1997). For the U.S. life insurance industry, Greene and Segal (2004) found that cost inefficiency had resulted in approximately a 1 per cent reduction in ROA.

4.7 Concluding Remarks

In this paper the cost structure and cost efficiency for an unbalanced sample of 357 agribusiness co-operatives in Canada (107 agricultural marketing, 250 agricultural supply) over the period of 1984-2001 is explored using random parameters stochastic frontier models. Initially model tests are conducted to explore if the observed technological differences are significant. Results indicate that pooling firms from different industries may not be appropriate due to differences in technology; thus separate frontiers are estimated for each industry.

Second, model selection tests are conducted to choose from among competing stochastic frontier models (i.e., the random effects model and the random parameters model). Model selection statistical tests suggest that the random parameters model outperforms the random effects stochastic frontier model. Thus, the parameters of the cost frontier are estimated using the random parameters approach. Consistent with expectations, the degree of cost efficiency is found to be higher for the random parameters approach as compared to that from the random effects (i.e., 20 per cent) approach.

A significant conclusion of this study is therefore that the degree of cost efficiency when taking into account unobserved heterogeneity in technology has been greater than would be suggested by the use of a conventional measure. These results suggest that, from a theoretical perspective, the choice of model may matter in the estimation of cost efficiency and its policy implications. Ignoring the reality that different co-operatives face different technologies may be misleading so far as cost efficiency is concerned.

Using the random parameters approach seven separate cost frontiers are estimated: i) four for agricultural marketing co-operatives (i.e., dairy, oilseeds and grain, fruit and vegetable, and honey and maple); and ii) three for agricultural supply co-operatives (i.e., farm supply, feed mill and farm petroleum co-operatives). The parameter estimates of the cost frontier and the resulting cost efficient scores indicate that there are statistically and economically significant cost inefficiencies in each category: that is, cost inefficiency of 25 per cent for dairy marketing co-operatives, 16 per cent for grain marketing co-operatives, 28 per cent for fruit and vegetable marketing co-operatives, 15 per cent for honey and maple marketing co-operatives, 22 per cent for farm supply co-operatives, 15 per cent for feed mill supply co-operatives, and 20 per cent for farm petroleum co-operatives. This evidence suggests that there may be significant potential for reducing the cost of adding value to co-operative members' outputs and/or providing services to co-operative members without loss in value added or cutback in services provided. For example, the cost of adding value for dairy marketing co-operatives would have been decreased by approximately 25 per cent, on average, had the co-operatives operated at their respective frontiers, while producing the same level of output. Thus, decision makers may focus on using resources of their co-operatives (i.e., labour, capital and material) more efficiently in addition to focusing on increasing their size.

The following conclusion may be made. Given the empirical evidence for the sample firms: (i) the approach used to estimate cost efficiency is important; ii) the estimated cost inefficiencies are statistically significant for all categories investigated in this study; (ii) there are significant inter-firm and inter-industry variations in cost efficiency; (iii) there is more variability in cost efficiency among firms in supply co-operatives as compared to those in agricultural marketing co-operatives; iv) smaller-sized and larger-sized agricultural supply, fruit and vegetable marketing, farm supply, feed mill and petroleum co-operatives are more cost efficient, and medium sized dairy co-operatives are more efficient; (v) with the exception of feed mill co-operatives, higher financial leverage has likely contributed to cost inefficiencies; and vi) there was very weak positive (negative) correlation between cost efficiency and profitability of marketing co-operatives (supply co-operatives).

What is causing efficiency to change with firm size? To answer this question further empirical research is warranted. But, an intuitive explanation for the relationship between firm size and efficiency within a specific industry is based on economies of scale and organizational theory. The basic implication of technological and organizational theories emphasizing transaction and agency costs of firm size is that within a specific industry (common production technology) and within a common institutional environment, firm size and efficiency may be linked through a trade-off of economies of scale and transactions costs and agency costs. Agency theory and transaction cost theory may help to explain why different size of firms exists at all. Given the existence of economies of scale, it could be expected that all co-operative activities would be conducted by large organizations. In situations where the benefits of small size are not sufficient to outweigh the benefits of economies of scale, large firms will predominate. In other cases, where agency and transaction costs are great or where economies of scale are not great, small size may be the optimum. In the case of fruit and vegetable marketing, feed mill, farm supply and farm petroleum co-operatives transaction and agency costs of size may be more than off-set the benefits from economies of scale for medium-sized co-operatives as compared to their smaller and larger counterparts. This is particularly possible if the organization costs curve is concave from the above and if at the same time the vertical distance between the average costs of production and organizing costs is at its maximum at medium firm size.

What is causing efficiency to decline with financial leverage for co-operatives in most of the industries investigated? Further empirical research my illuminate the latent causes of the inverse relationship. One explanation for the inverse relationship between cost efficiency and financial leverage may be that sticking to co-operative principles has made it difficult for co-operatives to lower financing costs by raising relatively cheaper funds from public investors/ stock market. This conclusion has important implications for co-operative incentive structure reform. Obtaining sufficient equity capital is expected to improve co-operative efficiency.

Table 4-1: Descriptive Statistics (Mean) for Agricultural Supply and Marketing Co-operatives by Activity (1984-2001)

Co-op activities	Total Costs (Million $)	Sales (Million $)	Value Added (Million $)	Return on Assets	Debt to Assets ratio	Total Assets (million $)	Employees (#)	Members (#)
Farm Supply	26.193	28.249	4.529	0.071	0.4515	8.966	63	1386
(n*t= 1293)	(120.770)	(128.859)	(22.972)	(0.082)	(0.2290)	(37.857)	(394)	(4319)
Feed Mills	11.275	12.428	2.329	0.067	0.4569	5.014	28	458
(n*t = 619)	(17.326)	(18.922)	(3.882)	(0.062)	(0.2118)	(8.221)	(41)	(668)
Farm Petroleum	6.358	7.120	1.259	0.131	0.1087	2.897	10	1670
(n*t = 1599)	(45.465)	(50.697)	(8.561)	(0.073)	(0.127)	(17.327)	(55)	(9,225)
Dairy	141.781	153.909	27.684	0.058	0.4807	49.829	401	1333
(n*t = 334)	(288.960)	(298.849)	(49.176)	(0.095)	(0.194)	(97.903)	(721)	(1,661)
Fruits	5.783	7.975	3.600	0.075	0.6085	3.884	24	117
(n*t = 213)	(7.248)	(10.301)	(6.237)	(0.188)	(0.279)	(5.807)	(52)	(122)
Vegetables	7.174	8.710	2.621	0.034	0.6909	3.057	24	95
(n*t = 250)	(8.823)	(11.463)	(4.636)	(0.148)	(0.247)	(4.505)	(41)	(177)
Oilseeds & Grain	668.742	704.935	74.234	0.019	0.6118	237.273	731	23571
(n*t = 280)	(973.593)	(1,016.699)	(110.371)	(0.105)	(0.170)	(383.334)	(1,084)	(32982)
Poultry & eggs	122.095	133.552	33.993	0.050	0.5784	39.137	672	441
(n*t = 65)	(107.355)	(114.471)	32.659)	(0.319)	(0.113)	(32.113)	(569)	(416)
Honey & Maple	12.641	14.095	2.732	0.038	0.6778	11.799	29	1127
(n*t =54)	(7.610)	(8.761)	(1.885)	(0.072)	(0.186)	(9.651)	(16)	(1,353)
Overall	46.729	50.099	7.377	0.081	0.3781	16.678	95	1887
(n*t = 4987)	(241.129)	(252.636)	(32.424)	(0.138)	(0.284)	(88.627)	(463)	(9096)

Note: Figures in parentheses are standard deviations. n*t refers to the number of observations. Note that the overall number of observations is greater than the individual industry sum as other categories are also included in the overall statistics.

Table 4-2: Tests Results for Model Selection between Homogeneous Technology and Heterogeneous Technologies Stochastic Frontier Models and the Associated Mean Efficiency Scores

	Homogeneous technology (Random Effects)			Heterogeneous Technologies (Random Parameters without heterogeneity)		
	Dairy	Grains	Fruit and Vegetable	Dairy	Grains	Fruit and Vegetable
LLF	-245.849	-53.283	-416.199	-175.361	-9.027	-356.495
AIC	517.698	132.565	858.397	396.723	64.054	758.990
BIC	567.243	172.296	912.187	484.379	134.347	854.158
Mean Cost Efficiency	0.288	0.046	0.116	0.746	0.839	0.738
SE of Cost Efficiency	0.182	0.121	0.200	0.120	0.085	0.097

Table 4-3: Parameter Estimates for Random Parameters Stochastic Cost Frontier Model for Dairy and Grain Marketing Co-operatives in Canada, 1984-2001

		Dairy		Grain	
Mean of Constant	β_0	17.908***	(0.243)	16.553***	(0.047)
Std. Deviation	$\Gamma_{\beta 0}$	1.240***	(0.023)	1.471***	(0.036)
Mean of Material	β_M	3.260***	(0.558)	0.900***	(0.128)
Std. Deviation	$\Gamma_{\beta M}$	0.763***	(0.054)	0.013	(0.080)
Mean of Labour	B_L	0.322***	(0.073)	0.180***	(0.056)
Std. Deviation	$\Gamma_{\beta l}$	0.501***	(0.054)	0.041	(0.059)
Mean of Value added	β_V	0.508***	(0.012)	0.802***	(0.010)
Std. Deviation	$\Gamma_{\beta V}$	0.169***	(0.007)	0.327***	(0.010)
Mean of Material^2	β_{MM}	-0.231	(1.042)	-0.558	(0.578)
Std. Deviation	$\Gamma_{\beta MM}$	1.498***	(0.390)	0.616	(0.402)
Mean of Material*Labour	β_{MW}	1.199***	(0.355)	-0.571*	(0.352)
Std. Deviation	$\Gamma_{\beta MW}$	0.267	(0.179)	0.348	(0.283)
Mean of Labour^2	B_{LL}	-1.087***	(0.387)	-0.126	(0.260)
Std. Deviation	Γ_{Bll}	0.982***	(0.174)	0.995***	(0.209)
Mean of Material*Value	β_{MV}	-0.138***	(0.041)	0.015	(0.039)
Std. Deviation	$\Gamma_{\beta MV}$	1.013***	(0.044)	0.145***	(0.034)
Mean of Labour*Value	B_{LV}	-0.093***	(0.033)	-0.063***	(0.018)
Std. Deviation	$\Gamma_{\beta LV}$	0.156***	(0.025)	0.064***	(0.022)
Mean of Value^2	β_{VV}	-0.192***	(0.007)	0.109***	(0.006)
Std. Deviation	$\Gamma_{\beta VV}$	0.043***	(0.004)	0.114***	(0.006)
Time	β_T	-0.063***	(0.019)	0.023***	(0.003)
σ		0.444***	(0.011)	0.260***	(0.011)
λ		1.970***	(0.168)	1.962***	(0.252)
σ_u		0.396		0.232	
σ_v		0.201		0.118	
LLF		-175.361		-9.027	
AIC		396.723		64.054	
BIC		484.379		134.347	
N		28		14	
N*T		334		157	

Note: *, **, *** refers to significance at a 10 per cent, 5 per cent and 1 per cent, respectively. Figures in parentheses are standard deviations.

Table 4-4: Input Elasticities of Substitution and Input Price Elasticities for Dairy and Grains Marketing Co-operatives in Canada (calculated at the mean value)

	Elasticities of Substitution					
	Dairy Co-operatives			Grain Co-operatives		
	Material	Labour	Capital	Material	Labour	Capital
Material	-0.457	14.831	-34.242	-0.725	-10.884	62.012
Labour	14.831	-118.233	-34.297	-10.884	-65.416	676.496
Capital	-34.242	-34.297	1048.732	62.012	676.496	-4643.203
	Input Price Elasticities of Demand					
Material	-0.397	12.882	-29.742	-0.079	-1.183	6.741
Labour	1.480	-11.798	-3.422	-16.011	-96.229	995.153
Capital	-1.083	-1.085	33.164	20.258	220.993	-1516.809

Table 4-5: Estimates of Average Returns to Scale for Dairy and Grains Marketing Co-operatives in Canada

Activities	Mean	Std. Dev.
Dairy	1.909	(48.936)
Oilseeds & Grains	1.412	(0.598)

Table 4-6: Distribution of Cost Efficiency for Dairy and Grains Marketing Co-operatives in Canada

Activity	Mean	Std.Dev.	Minimum	Maximum	CV
Dairy	0.746	0.120	0.309	0.946	0.161
Grains	0.839	0.085	0.488	0.965	0.101

Table 4-7: Panel Average Dairy Marketing Co-operative Sample Observations Characteristics by Cost Efficiency Index Categories in Canada

	Efficiency Scores						
Characteristics	< 0.50	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost(a)	102.924	141.131	136.688	161.241	131.369	100.008	141.781
Sales(a)	103.055	141.765	140.802	180.081	143.271	108.958	153.909
Value Added(a)	5.772	12.398	18.014	39.056	25.009	21.333	27.684
Assets(a)	34.828	49.341	36.770	59.270	47.637	37.078	49.829
ROA(b)	0.016	0.023	0.039	0.067	0.069	0.064	0.058
DTA(b)	0.627	0.531	0.479	0.465	0.469	0.454	0.481
Employees (c)	126	292	314	516	372	320	401
Members(c)	953	1041	1421	1692	1069	513	1333
N	18	23	44	135	98	16	334

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; DTA= Debt to asset ratio; and N = number of observations in a panel.

Table 4-8. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Dairy Co-operative Firms over the Period 1984-2001

Dairy	Average Efficiency			Average Sales (million $)			Average Assets (Million $)			Average Debt to Asset ratio		
Firm	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
12	0.783	0.737	0.818	372.039	336.404	407.303	101.984	93.775	113.376	0.718	0.693	0.740
16	0.758	0.549	0.873	57.699	33.682	79.128	22.313	11.029	39.463	0.437	0.290	0.563
32	0.792	0.767	0.821	139.587	115.232	191.109	46.230	36.124	70.586	0.501	0.318	0.965
38	0.788	0.760	0.810	184.886	155.496	232.308	57.201	41.335	82.533	0.571	0.511	0.694
161	0.760	0.650	0.800	193.827	160.340	238.073	83.561	52.974	126.587	0.409	0.180	0.752
179	0.774	0.622	0.834	8.935	6.866	10.325	4.368	3.023	5.095	0.510	0.468	0.560
184	0.763	0.673	0.872	0.960	0.641	1.217	0.251	0.180	0.339	0.235	0.123	0.373
186	0.742	0.627	0.888	37.979	20.105	46.565	14.190	10.315	21.000	0.667	0.569	0.782
189	0.752	0.674	0.879	15.958	9.757	18.396	6.450	5.192	7.306	0.305	0.242	0.357
211	0.785	0.688	0.918	2.523	1.951	3.547	1.567	0.932	2.001	0.123	0.083	0.264
212	0.756	0.646	0.831	183.226	145.363	266.038	52.703	36.493	82.719	0.469	0.365	0.630
224	0.792	0.702	0.887	6.411	4.174	8.702	3.690	2.820	5.089	0.330	0.197	0.473
226	0.773	0.486	0.926	13.402	9.197	20.172	4.510	2.655	7.865	0.456	0.352	0.557
257	0.628	0.408	0.907	1.320	0.312	6.179	0.409	0.110	1.702	0.489	0.075	0.881
269	0.768	0.768	0.768	0.085	0.085	0.085	0.125	0.125	0.125	0.174	0.174	0.174
276	0.768	0.566	0.928	970.688	504.506	1470.948	300.484	185.171	505.524	0.570	0.402	0.704
287	0.766	0.619	0.875	0.504	0.344	0.818	0.072	0.046	0.108	0.325	0.015	0.783
299	0.685	0.403	0.899	175.241	69.556	321.883	59.539	39.945	98.566	0.567	0.369	0.805
302	0.791	0.566	0.876	68.695	52.523	88.024	31.756	24.732	40.887	0.572	0.479	0.716
319	0.615	0.309	0.886	158.900	143.614	173.176	36.764	22.179	49.058	0.531	0.410	0.780
326	0.778	0.489	0.946	19.531	12.763	24.798	6.198	3.374	8.502	0.553	0.297	0.748
343	0.763	0.538	0.931	27.420	14.717	37.848	9.199	7.537	11.473	0.638	0.501	0.750
344	0.604	0.458	0.892	119.090	52.713	271.678	49.928	15.849	115.351	0.584	0.459	0.822
345	0.749	0.575	0.918	2.294	2.044	2.589	0.588	0.332	0.771	0.384	0.178	0.645
350	0.795	0.545	0.909	1.031	0.578	1.570	0.340	0.077	0.833	0.348	0.048	0.696
417	0.827	0.671	0.906	1169.710	824.332	1673.501	368.478	123.253	625.340	0.750	0.558	0.834
419	0.752	0.751	0.754	1696.589	1543.078	1850.100	578.351	508.036	648.665	0.619	0.609	0.629
420	0.779	0.779	0.779	95.668	95.668	95.668	84.223	84.223	84.223	0.492	0.492	0.492

Table 4-9. Panel Average Grain Marketing Co-operative Sample Observations Characteristics by Cost Efficiency Indices Categories in Canada

	Efficiency Scores					
Characteristics	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost$^{(a)}$	1641.202	966.661	792.426	532.839	717.516	668.742
Sales$^{(a)}$	1633.213	1000.983	831.392	565.430	768.335	704.935
Value Added$^{(a)}$	80.954	87.951	78.000	64.180	93.655	74.233
Assets$^{(a)}$	654.390	323.839	237.055	198.993	254.165	237.273
ROA$^{(b)}$	-0.069	-0.001	0.024	0.031	0.005	0.019
DTA$^{(b)}$	0.696	0.709	0.625	0.593	0.616	0.612
Employees $^{(c)}$	1398	881	821	617	826	731
Members$^{(c)}$	29508	28078	23943	21662	26342	23571
N	5	8	24	87	33	157

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; leverage= Debt to asset ratio; and N = number of observations in a panel.

Table 4-10. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Grain Co-operative Firms over the Period 1984-2001

Grain	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
29	0.830	0.665	0.964	1336.36	870.74	2146.73	483.01	320.34	711.77	0.581	0.445	0.706
65	0.812	0.584	0.935	2745.07	1853.81	4322.35	1027.69	677.25	1636.40	0.562	0.383	0.679
166	0.862	0.862	0.862	1.12	1.12	1.12	0.12	0.12	0.12	0.728	0.728	0.728
188	0.833	0.695	0.930	1217.44	557.71	3152.56	423.02	156.75	1277.09	0.582	0.391	0.748
198	0.881	0.861	0.902	0.32	0.32	0.32	0.59	0.59	0.59	0.020	0.020	0.020
213	0.851	0.727	0.917	13.78	8.03	19.14	2.45	1.47	4.08	0.806	0.669	1.000
216	0.849	0.727	0.914	34.75	13.16	58.57	8.38	3.10	14.88	0.677	0.512	0.813
219	0.871	0.731	0.928	30.60	10.09	59.02	6.97	2.20	17.71	0.595	0.426	0.725
231	0.826	0.561	0.965	1.49	0.98	2.93	0.41	0.35	0.49	0.515	0.383	0.692
236	0.857	0.743	0.917	13.21	7.90	21.89	3.26	1.80	5.48	0.460	0.193	0.719
258	0.823	0.653	0.939	7.66	3.65	9.69	3.60	0.57	5.20	0.964	0.894	1.000
412	0.875	0.806	0.936	1053.53	880.36	1283.62	370.00	326.04	429.43	0.692	0.634	0.763
418	0.799	0.488	0.952	1332.61	994.61	1789.83	80.15	47.54	126.54	0.717	0.605	0.872

Table 4-11: Random Parameter Tobit Regression Parameters Estimates for the Determinants of Cost Efficiency for Dairy and Grain Marketing Co-operatives in Canada, 1984-2001

Variables		Dairy Co-operatives		Grain Co-operatives	
Mean Constant	δ_0	0.807***	(0.011)	8.97E-01***	(2.09E-02)
Std. Deviation	$\Gamma_{\delta 0}$	0.003	(0.004)	9.45E-05	(5.15E-03)
Mean Sales	δ_S	0.008***	(0.002)	-6.78E-04	(6.93E-04)
Std. Deviation	$\Gamma_{\delta S}$	0.004***	(0.001)	7.34E-06	(2.36E-04)
Mean Sales^2	δ_{SS}	-0.002***	(0.0002)	-3.01E-07	(1.10E-05)
Std. Deviation	$\Gamma_{\delta SS}$	0.008***	(0.001)	1.04E-08	(4.03E-06)
Mean Debt/Asset ratio	δ_{DA}	-0.125***	(0.023)	-7.94E-02**	(3.22E-02)
Std. Deviation	$\Gamma_{\delta DA}$	0.074***	(0.008)	1.10E-03	(7.84E-03)
σ		0.102***	(0.002)	8.25E-02***	(2.44E-03)
LLF		258.123		168.8704	
Chi squared		516.243		337.7407	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-12: Tests Results for Model Selection between Heterogeneous Technologies Stochastic Cost Frontier Model without and without Heterogeneity in the Means of the Random Parameters for Fruit and Vegetable Co-operatives in Canada, 1984-2001

	Without Heterogeneity	With Heterogeneity
AIC	758.990	761.440
BIC	854.158	897.985
LLF	-356.495	-347.720
Number of parameters	23	33
Likelihood Ratio	17.551	
Critical Chi-square value (5 per cent, 30 df)	18.307	
Critical Chi-square value (10 per cent, 30 df)	15.987	
Mean of cost efficiency	0.738	0.720
Standard deviation of cost efficiency	0.097	0.117

Table 4-13: Parameter Estimates for Random Parameter Stochastic Cost Frontier Model for Fruit and Vegetable Marketing Co-operatives in Canada, 1984-2001

Variables	Posterior Means for Random parameters (β's)		Posterior Heterogeneity in the means (Fruit Dummy) – (ξ's)		Posterior Standard Deviation of Random Parameters (Γ_β's)	
Constant	14.568***	(0.078)	-0.307***	(0.078)	1.121***	(0.020)
Raw	0.351	(0.340)	-1.745***	(0.411)	0.519***	(0.082)
Labour	0.432***	(0.121)	-0.281**	(0.142)	0.160***	(0.028)
Value Added	0.555***	(0.037)	-0.345***	(0.044)	0.269***	(0.006)
Raw^2	-0.409	(1.674)	-5.817***	(2.240)	0.711	(0.704)
Raw*Labour	-0.045	(0.485)	0.229	(0.664)	1.209***	(0.227)
Labour^2	-1.733***	(0.522)	2.832***	(0.639)	1.373***	(0.142)
Raw*Value	0.062	(0.113)	-0.203	(0.140)	0.033	(0.029)
Labour*Value	0.188***	(0.055)	-0.160***	(0.064)	0.149***	(0.011)
Value^2	0.036***	(0.014)	-0.021	(0.017)	0.109***	(0.003)
Time	0.024***	(0.003)	--	--	--	--
σ_u	0.460					
σ_v	0.223					
σ	0.511***	(0.008)				
λ	2.061***	(0.100)				
LLF	-347.720					
Firms	54					
N	463					
Halton draws	200					

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-14: Input Elasticities of Substitution and Input Price Elasticities for Fruit and Vegetable Co-operatives

	Input Substitution Elasticities			Input Demand Price Elasticities		
	Material	Labour	Capital	Material	Labour	Capital
Material	-0.993	0.658	10.692	-0.763	0.506	8.219
Labour	0.658	-64.566	172.255	0.112	-10.184	0.894
Capital	10.692	172.255	-616.625	0.651	12.387	-0.093

Table 4-15: Average Returns to Scale for Fruit and Vegetable Co-operatives in Canada, 1984- 2001

Co-operative	Mean	Std. Dev.
Fruit	3.249	0.971
Vegetable	3.284	0.782
Overall	3.268	0.873

Table 4-16: Distribution of Cost Efficiency for Fruit and Vegetable Co-operatives in Canada, 1984-2001

Co-operative	Mean	Std. Dev.	Minimum	Maximum	CV
Fruit	0.720	0.116	0.257	0.918	0.161
Vegetable	0.720	0.117	0.032	0.959	0.163
Overall	0.720	0.117	0.032	0.959	0.163

Table 4-17: Panel Average Fruit and Vegetable Co-operative Sample Observations Characteristics by Efficiency Indices Categories, 1984-2001

	Efficiency Scores						
Characteristics	< 0.50	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost[(a)]	9.825	8.868	8.104	5.961	4.769	2.182	6.534
Sales[(a)]	10.571	10.357	9.621	7.880	7.130	4.492	8.372
Value Added[(a)]	1.403	3.025	2.910	3.186	3.379	3.718	3.071
Assets[(a)]	2.243	3.727	3.722	3.570	2.916	5.110	3.437
ROA[(b)]	0.049	0.027	0.033	0.057	0.071	0.092	0.052
Leverage[(b)]	0.637	0.713	0.682	0.641	0.629	0.656	0.653
Employee[(c)]	10	18	22	27	25	35	24
Member[(c)]	82	116	131	102	86	106	105
N	24	35	104	192	99	9	463

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; leverage= liability to asset ratio; and N = number of observations in a panel.

Table 4-18. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Fruit and Vegetable Co-operative Firms over the Period 1984-2001

Fruit	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
2	0.710	0.353	0.898	10.295	5.306	18.948	1.913	1.040	3.471	0.374	0.161	0.663
4	0.753	0.600	0.837	2.707	1.760	4.395	0.611	0.258	1.026	0.757	0.317	1.000
5	0.725	0.521	0.925	37.587	12.804	48.711	24.083	16.326	29.401	0.655	0.506	0.829
6	0.695	0.422	0.906	7.752	4.363	16.188	3.836	2.975	5.181	0.953	0.706	0.990
8	0.752	0.605	0.857	15.138	13.073	17.417	8.307	5.645	12.846	0.846	0.673	0.960
11	0.707	0.481	0.838	52.494	48.593	59.283	11.077	8.918	12.299	0.759	0.650	0.941
13	0.719	0.577	0.914	14.839	11.526	18.272	9.531	6.888	11.197	0.610	0.318	0.871
17	0.736	0.507	0.847	9.030	5.994	17.318	3.816	2.672	5.012	0.914	0.863	0.981
18	0.697	0.486	0.867	17.298	12.771	22.383	2.710	2.408	3.023	0.884	0.728	1.000
19	0.713	0.448	0.864	13.427	5.016	23.577	4.223	1.724	7.318	0.781	0.467	0.942
21	0.737	0.441	0.845	9.132	3.115	22.271	2.026	1.022	2.990	0.636	0.295	0.965
22	0.678	0.473	0.842	13.152	7.573	21.347	1.997	1.150	3.277	0.767	0.719	0.811
24	0.737	0.032	0.892	0.206	0.031	1.721	0.057	0.037	0.118	0.125	0.020	0.519
25	0.632	0.319	0.959	3.380	0.631	4.350	0.360	0.198	0.718	0.849	0.749	1.000
28	0.738	0.645	0.799	1.180	1.044	1.387	1.665	1.612	1.780	0.610	0.590	0.637
53	0.734	0.358	0.824	8.746	2.772	23.765	0.971	0.116	3.732	0.591	0.459	0.798
55	0.734	0.606	0.864	2.601	1.820	3.748	1.186	0.548	2.230	0.695	0.578	0.785
63	0.615	0.417	0.842	1.254	0.248	1.780	0.120	0.073	0.176	0.724	0.452	0.873
64	0.728	0.638	0.756	0.054	0.053	0.060	0.212	0.160	0.420	0.507	0.442	0.767
167	0.721	0.600	0.794	0.112	0.036	0.213	0.254	0.215	0.302	0.997	0.990	1.000
223	0.735	0.513	0.900	0.531	0.296	0.787	0.168	0.129	0.255	0.782	0.279	1.000
229	0.692	0.433	0.911	0.862	0.104	1.910	0.354	0.127	0.715	0.543	0.215	0.747
233	0.744	0.621	0.860	11.299	7.694	16.726	8.655	6.434	11.228	0.902	0.864	0.933
235	0.720	0.500	0.885	15.223	4.353	27.598	3.689	1.082	6.640	0.558	0.339	0.713
244	0.751	0.678	0.839	11.028	5.688	15.214	4.565	2.413	7.790	0.419	0.177	0.674
248	0.715	0.624	0.849	3.752	3.046	4.361	1.601	1.257	1.845	0.375	0.282	0.445

Table 4-18 continued

250	0.740	0.604	0.823	1.423	1.140	1.705	1.105	0.660	1.538	0.862	0.789	0.916
254	0.748	0.475	0.908	9.167	5.661	13.998	5.994	3.298	12.648	0.916	0.828	1.000
265	0.734	0.680	0.826	5.843	4.128	6.451	0.782	0.678	0.939	0.773	0.726	0.844
266	0.724	0.606	0.809	0.515	0.333	0.780	0.246	0.169	0.332	0.913	0.888	0.941
277	0.772	0.666	0.837	0.177	0.143	0.190	0.278	0.254	0.345	0.472	0.412	0.575
279	0.732	0.639	0.860	0.502	0.319	0.711	0.341	0.277	0.417	0.257	0.161	0.440
284	0.735	0.592	0.812	1.245	0.994	1.443	2.191	1.837	3.140	0.648	0.540	0.829
351	0.642	0.257	0.918	0.282	0.056	0.603	0.171	0.013	0.471	0.207	0.000	0.387
352	0.701	0.484	0.894	0.325	0.117	0.778	0.346	0.121	0.527	0.585	0.137	0.832
353	0.720	0.469	0.861	0.075	0.018	0.206	0.074	0.013	0.120	0.065	0.000	0.354
354	0.736	0.586	0.821	0.571	0.336	1.226	0.370	0.224	0.679	0.258	0.052	0.393
355	0.723	0.412	0.866	0.531	0.201	0.857	0.397	0.137	0.671	0.386	0.007	0.680
359	0.668	0.356	0.869	0.814	0.129	4.672	0.204	0.049	0.451	0.681	0.315	0.962
360	0.698	0.502	0.909	0.572	0.305	0.921	0.347	0.205	0.603	0.549	0.275	0.848
363	0.711	0.489	0.928	3.343	0.415	6.511	1.048	0.385	2.111	0.856	0.473	0.932
364	0.741	0.671	0.874	1.260	0.889	1.679	0.660	0.514	0.740	0.939	0.886	1.000
365	0.721	0.596	0.800	1.560	1.176	1.934	0.816	0.610	1.213	0.811	0.577	1.000
367	0.707	0.545	0.846	1.666	1.149	2.222	1.105	0.951	1.369	0.711	0.664	0.789
380	0.731	0.631	0.856	1.411	1.068	1.671	0.881	0.642	1.120	0.231	0.140	0.334

Table 4-19: Random Parameter Tobit Regression Parameters Estimates for the Determinants of Cost Efficiency for Fruit and Vegetable Co-operatives in Canada, 1984-2001

Variables	Parameters	Estimates	
Mean Constant	δ_0	0.749***	(0.010)
Std. Deviation of Constant	$\Gamma_{\delta 0}$	0.001	(0.004)
Mean Sales	δ_S	-0.188***	(0.049)
Std. Deviation of Sales	$\Gamma_{\delta S}$	0.001	(0.015)
Mean Sales^2	δ_{SS}	0.145***	(0.056)
Std. Deviation of Sales^2	$\Gamma_{\delta SS}$	0.001	(0.020)
Mean Debt/Asset ratio	δ_{DA}	-0.014	(0.014)
Std. Deviation of Debt/Asset ratio	$\Gamma_{\delta DA}$	0.023***	(0.005)
σ		0.114***	(0.002)
LLF		342.876	
Chi squared		685.752	
Firms		54	
Firms x Time		463	
Halton		100	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-20: Parameter Estimates for Random Parameter Stochastic Cost Frontier Model for Honey and Maple Marketing Co-operatives, 1984-2001

Variables	Parameters	Estimates	
Mean Constant	β_0	16.313***	(0.064)
Std. Deviation of Constant	$\Gamma_{\beta 0}$	0.017	(0.016)
Mean Material	β_M	0.255***	(0.095)
Std. Deviation of Material	$\Gamma_{\beta M}$	0.029	(0.093)
Mean Labour	B_L	0.221***	(0.083)
Std. Deviation of Labour	$\Gamma_{\beta L}$	0.045	(0.067)
Mean Value added	β_V	0.803***	(0.028)
Std. Deviation of Value added	$\Gamma_{\beta V}$	0.258***	(0.018)
Time		0.038***	(0.004)
σ		0.237***	(0.022)
λ		1.735***	(0.369)
σu		0.20556	
σv		0.11846	
LLF		11.1537	
AIC		-0.307	
BIC		21.571	
N		5	
NxT		54	
Halton		100	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-21: Panel Average Honey and Maple Co-operative Sample Observations Characteristics by Efficiency Indices, 1984-2001

	Efficiency Scores				
Characteristics	< 0.70	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost[(a)]	23.021	14.532	11.550	11.989	12.641
Sales[(a)]	24.528	15.917	12.809	13.853	14.095
Value Added[(a)]	3.661	2.529	2.486	3.121	2.732
Assets[(a)]	24.593	13.530	10.162	11.822	11.799
ROA[(b)]	-0.015	0.000	0.036	0.069	0.038
DTA[(b)]	0.746	0.769	0.669	0.646	0.678
Employees [(c)]	43	27	28	30	29
Members[(c)]	1832	624	1044	1353	1127
N	3	6	30	15	54

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= returns on assets; leverage= Debt to asset ratio; and N = number of observations in a panel.

Table 4-22. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Honey Co-operative Firms over the Period 1984-2001

Honey	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
34	0.865	0.692	0.940	10.581	6.888	18.327	7.850	4.893	11.334	0.763	0.628	0.991
185	0.847	0.721	0.958	9.769	6.292	14.838	6.644	5.153	9.683	0.792	0.723	0.876
283	0.844	0.637	0.941	23.207	12.314	46.951	21.709	7.920	51.498	0.486	0.154	0.847
346	0.884	0.884	0.884	0.167	0.167	0.167	0.230	0.230	0.230	0.648	0.648	0.648
385	0.866	0.857	0.874	16.567	15.635	17.498	17.660	16.083	19.237	0.490	0.401	0.580

Table 4-23: Random Parameter Tobit Regression Parameters Estimates for Honey and Maple Co-operatives, 1984-2001

Variables	Parameters	Estimates	
Mean Constant	δ_0	0.984***	(0.045
Std. Deviation of Constant	$\Gamma_{\delta 0}$	0.000	(0.008)
Mean Sales	δ_S	-0.097	(0.155
Std. Deviation of Sales	$\Gamma_{\delta S}$	0.0002	(0.024)
Mean Sales^2	δ_{SS}	-0.091	(0.162
Std. Deviation of Sales^2	$\Gamma_{\delta SS}$	0.0001	(0.043)
Mean Debt/Asset ratio	δ_{DA}	-0.139***	(0.038
Std. Deviation of Debt/Asset ratio	$\Gamma_{\delta DA}$	0.000	(0.010)
σ		0.063***	(0.006
LLF		72.490	
Chi squared		144.980	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-24: Parameter Estimates for Random Parameters Stochastic Cost Frontier Model for Farm Supply, Feed Mills and Farm Petroleum Co-operatives in Canada

Variables	Farm Supply		Feed Mills		Farm Petroleum	
Mean of Constant	14.527***	(0.019)	14.329***	(0.011)	13.818***	(0.012)
Std. Deviation of Constant	0.385***	(0.005)	0.798***	(0.010)	0.465***	(0.005)
Mean of Raw	0.621***	(0.065)	0.663***	(0.101)	0.665***	(0.042)
Std. Deviation of Raw	0.656***	(0.020)	0.252***	(0.020)	0.621***	(0.006)
Mean of Labour	-0.079***	(0.022)	0.097***	(0.031)	0.063***	(0.018)
Std. Deviation of Labour	0.082***	(0.014)	0.012	(0.016)	0.030**	(0.013)
Mean of Value Added	0.731***	(0.003)	0.685***	(0.007)	0.120***	(0.008)
Std. Deviation of Value Added	0.225***	(0.002)	0.043***	(0.003)	0.050***	(0.010)
Mean of Raw^2	1.162***	(0.361)	-0.217	(0.393)	-1.927***	(0.184)
Std. Deviation of Raw^2	1.396***	(0.161)	0.097	(0.115)	0.600***	(0.101)
Mean of Raw*Labour	1.099***	(0.098)	-0.265**	(0.124)	-0.281***	(0.105)
Std. Deviation of Raw*Labour	0.983***	(0.071)	0.623***	(0.084)	0.181***	(0.068)
Mean of Labour^2	-1.051***	(0.097)	-0.087	(0.094)	-0.077	(0.101)
Std. Deviation of Labour^2	0.597***	(0.065)	0.222***	(0.077)	0.044	(0.053)
Mean of Raw*Value	0.057***	(0.014)	-0.099***	(0.024)	0.113***	(0.021)
Std. Deviation of Raw*Value	0.455***	(0.010)	0.439***	(0.018)	0.359***	(0.016)
Mean of Labour*Value	-0.053***	(0.011)	0.032**	(0.015)	0.032**	(0.015)
Std. Deviation of Labour*Value	0.299***	(0.005)	0.028***	(0.008)	0.205***	(0.011)
Mean of Value^2	-0.054***	(0.002)	-0.091***	(0.003)	-0.125***	(0.004)
Std. Deviation of Value^2	0.097***	(0.001)	0.278**	(0.002)	0.078***	(0.004)
	Non-random Parameter					
Time	-0.004*	(0.002)	0.023***	(0.001)	0.023***	(0.001)
σ_u	0.175		0.097		0.170	
σ_v	0.162		0.132		0.133	
σ	0.239***	(0.002)	0.163***	(0.003)	0.216***	(0.001)
λ	1.081***	(0.040)	0.734***	(0.047)	1.272***	(0.029)
LLF	-44.553		151.046		206.675	
Firms	93		42		115	
N	1293		619		1599	
Halton draws	150		150		150	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance. Figures in parentheses are standard deviations

Table 4-25: Input Substitution Elasticities and Input Price Elasticities for Farm Supply, Feed Mills and Farm Petroleum Co-operatives in Canada

	Input Substitution Elasticities								
	Farm Supply			Feed Mills			Farm Petroleum		
	Material	Labour	Capital	Material	Labour	Capital	Material	Labour	Capital
Material	1.658	14.770	-111.534	-1.656	-2.302	22.159	-5.633	-3.464	82.085
Labour	14.770	-140.049	-22.573	-2.302	-20.546	151.240	-3.464	-29.024	170.078
Capital	-111.534	-22.573	4461.386	22.159	151.240	-1291.913	82.085	170.078	-2833.610
	Input Price Elasticities								
	Farm Supply			Feed Mills			Farm Petroleum		
	Material	Labour	Capital	Material	Labour	Capital	Material	Labour	Capital
Material	1.471	13.107	-98.978	-1.463	-2.033	19.575	-5.069	-3.117	73.858
Labour	1.328	-12.596	-2.030	-0.209	-1.867	13.741	-0.242	-2.031	11.899
Capital	-2.525	-0.511	101.008	0.571	3.900	-33.315	2.484	5.147	-85.757

Table 4-26: Returns to Scale for Agricultural Supply and Marketing Co-operatives

	Mean	Std. Dev.
Farm Supply	1.480	0.216
Feed Mills	1.761	0.435
Farm Petroleum	12.027	182.172

Table 4-27: Distribution of Cost Efficiency for Random Parameters Model without Heterogeneity in Mean for Farm Supply Co-operatives

	Mean	Std. Dev.	Minimum	Maximum	CV
Farm Supply	0.778	0.168	0.190	0.986	0.216
Feed Mills	0.854	0.120	0.463	0.991	0.141
Farm Petroleum	0.802	0.188	0.011	0.987	0.234

Table 4-28: Panel Average Farm Supply Co-operative Sample Observations Characteristics by Efficiency Indices, 1984-2001

	Efficiency Scores						
Characteristics	< 0.50	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost(a)	222.745	34.669	13.807	8.488	4.057	1.658	26.146
Sales(a)	239.616	37.716	14.835	9.241	4.426	1.882	28.209
Value Added(a)	36.766	6.320	2.555	1.706	0.839	0.460	4.532
Assets(a)	67.239	14.095	6.828	4.286	1.902	0.976	9.005
ROA(b)	0.119	0.022	0.043	0.063	0.075	0.073	0.070
DTA(b)	0.690	0.654	0.494	0.482	0.412	0.353	0.454
Employees (c)	513	75	35	24	13	7	63
Members(c)	5122	2006	1352	1333	1007	465	1373
N	115	58	138	254	380	348	1293

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; leverage= liability to asset ratio; and N = number of observations in a panel.

Table 4-29: Panel Average Feed Mills Co-operative Sample Observations Characteristics by Efficiency Indices, 1981 - 2004

	Efficiency Scores						
Characteristics	< 0.50	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost(a)	89.029	67.057	34.816	14.022	6.880	2.287	10.916
Sales(a)	91.104	72.605	37.897	15.715	7.549	2.734	12.025
Value Added(a)	7.556	12.420	6.909	2.922	1.476	0.759	2.257
Assets(a)	31.058	30.962	15.662	5.342	3.035	1.218	4.812
ROA(b)	0.043	0.048	0.080	0.085	0.072	0.061	0.068
DTA(b)	0.606	0.664	0.549	0.505	0.485	0.388	0.451
Employees (c)	127	152	88	30	19	8	27
Members(c)	794	851	721	588	418	356	458
N	5	19	64	87	125	319	619

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; leverage= Debt to asset ratio; and N = number of observations in a panel.

Table 4-30: Panel Average Farm Petroleum Co-operative Sample Observations Characteristics by Efficiency Indices, 1984-2001

	Efficiency Scores						
Characteristics	< 0.50	0.5 - 0.59	0.60 - 0.69	0.70 - 0.79	0.80 - 0.89	> 0.89	Mean
Cost(a)	71.271	3.321	2.592	1.975	1.463	0.833	6.358
Sales(a)	79.805	3.710	2.901	2.203	1.632	0.941	7.120
Value Added(a)	13.726	0.680	0.550	0.420	0.311	0.198	1.259
Assets(a)	28.415	1.917	1.630	1.295	0.995	0.592	2.897
ROA(b)	0.180	0.170	0.152	0.137	0.133	0.109	0.131
DTA(b)	0.183	0.167	0.122	0.089	0.091	0.096	0.109
Employees (c)	92	7	6	5	3	2	10
Members(c)	15686	1411	1170	662	518	388	1670
N	111	127	171	169	327	694	1599

Note: (a) million Canadian dollars; (b) = ratio; (c) = number; ROA= return on assets; leverage= Debt to asset ratio; and N = number of observations in a panel.

Table 4-31. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Farm Supply Co-operative Firms over the Period 1984-2001

Farm Supply	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
9	0.923	0.875	0.948	2.420	1.340	3.902	0.787	0.320	1.286	0.412	0.248	0.664
10	0.528	0.351	0.611	64.654	43.484	96.174	26.488	14.850	45.714	0.872	0.755	1.000
20	0.928	0.901	0.944	0.938	0.687	1.225	0.378	0.337	0.402	0.334	0.231	0.487
23	0.806	0.543	0.952	0.622	0.329	0.864	0.078	0.049	0.109	0.860	0.028	1.000
31	0.822	0.697	0.886	8.271	4.836	17.393	4.546	2.387	8.625	0.246	0.071	0.583
42	0.759	0.596	0.873	18.150	10.715	40.654	8.966	3.505	21.276	0.567	0.320	0.950
58	0.719	0.606	0.771	12.264	9.721	14.593	6.868	4.765	8.692	0.604	0.495	0.857
60	0.421	0.406	0.432	58.466	45.635	76.223	12.104	8.804	17.565	0.870	0.746	0.966
95	0.840	0.779	0.884	4.644	3.485	7.723	2.463	1.297	3.935	0.129	0.021	0.261
96	0.885	0.871	0.891	2.942	2.575	3.371	1.744	1.675	1.840	0.193	0.086	0.323
136	0.864	0.817	0.898	4.885	2.297	8.980	2.726	0.971	5.066	0.138	0.016	0.246
148	0.833	0.690	0.903	6.292	2.986	14.477	3.482	1.445	6.935	0.281	0.157	0.417
157	0.859	0.779	0.916	4.245	3.107	5.403	2.421	1.695	3.383	0.232	0.043	0.475
173	0.815	0.689	0.986	4.531	3.001	7.098	2.589	1.348	3.895	0.291	0.125	0.403
175	0.831	0.735	0.896	6.031	2.529	12.518	2.918	1.001	6.678	0.216	0.099	0.310
176	0.915	0.871	0.937	2.270	1.495	3.145	1.537	0.792	2.264	0.163	0.037	0.272
178	0.694	0.629	0.751	19.589	13.992	28.562	9.144	5.449	15.283	0.378	0.177	0.745
181	0.711	0.567	0.769	17.312	10.777	43.604	9.124	4.513	23.073	0.206	0.130	0.313
182	0.755	0.668	0.794	9.314	6.129	16.470	4.675	2.838	8.828	0.304	0.240	0.452
190	0.908	0.867	0.936	1.583	1.251	2.212	0.981	0.551	1.518	0.138	0.055	0.271
191	0.759	0.614	0.874	15.143	6.287	27.282	9.942	2.790	18.923	0.395	0.345	0.425
194	0.386	0.260	0.478	0.190	0.123	0.228	0.012	0.005	0.019	0.647	0.073	0.816
197	0.572	0.552	0.592	21.932	20.237	23.628	7.064	6.472	7.657	0.616	0.588	0.644
198	0.986	0.986	0.986	0.324	0.324	0.324	0.589	0.589	0.589	0.020	0.020	0.020
200	0.514	0.439	0.608	20.807	2.297	53.060	3.570	1.749	7.981	0.756	0.676	0.855

Table 4-31 continued

205	0.549	0.448	0.698	37.287	12.975	69.277	13.421	4.003	26.899	0.595	0.369	0.738
206	0.884	0.825	0.935	2.389	1.778	2.876	0.735	0.490	0.798	0.386	0.319	0.558
207	0.742	0.570	0.872	10.776	3.518	22.726	4.143	1.098	9.473	0.653	0.471	0.844
214	0.842	0.754	0.897	4.788	2.682	8.459	1.501	0.597	2.795	0.608	0.453	0.816
215	0.824	0.730	0.861	6.466	3.823	8.949	2.573	1.051	4.258	0.515	0.348	0.621
217	0.841	0.631	0.930	1.663	1.252	1.990	1.108	0.671	1.307	0.108	0.066	0.190
221	0.915	0.884	0.939	2.347	2.144	2.517	0.829	0.647	1.077	0.613	0.390	0.948
222	0.919	0.899	0.940	3.376	3.169	3.671	2.176	1.086	3.015	0.144	0.097	0.269
230	0.652	0.579	0.764	2.439	1.934	3.010	0.315	0.189	0.402	0.325	0.016	0.510
232	0.486	0.387	0.570	59.301	39.350	89.081	20.255	12.106	29.252	0.648	0.461	0.822
237	0.812	0.728	0.854	6.135	3.525	9.709	2.349	1.279	4.002	0.600	0.382	0.811
239	0.611	0.501	0.730	28.285	7.968	55.466	10.152	5.409	19.844	0.434	0.274	0.584
240	0.767	0.719	0.837	10.637	7.164	19.877	3.626	1.824	7.426	0.524	0.305	0.625
241	0.772	0.707	0.826	6.325	4.270	9.818	2.179	1.126	3.801	0.603	0.490	0.722
242	0.492	0.401	0.590	86.141	35.869	145.829	32.520	9.521	55.519	0.658	0.454	0.732
243	0.915	0.883	0.935	2.476	1.614	3.921	1.266	0.673	2.512	0.646	0.551	0.765
245	0.723	0.656	0.786	9.236	7.008	11.362	2.989	2.343	3.802	0.571	0.431	0.748
255	0.869	0.767	0.921	4.113	2.407	6.369	1.441	0.923	1.955	0.368	0.173	0.591
261	0.920	0.856	0.969	2.838	1.613	3.305	0.815	0.747	0.899	0.710	0.685	0.787
262	0.896	0.864	0.986	4.522	4.364	4.937	1.915	1.711	2.053	0.935	0.893	1.000
263	0.825	0.803	0.847	6.402	5.222	7.090	2.232	1.860	2.497	0.855	0.729	0.992
271	0.717	0.459	0.907	14.691	7.315	25.412	5.774	2.807	8.895	0.625	0.532	0.713
275	0.882	0.786	0.930	2.516	1.366	3.082	1.242	0.579	1.827	0.184	0.107	0.332
278	0.707	0.624	0.796	13.365	9.514	19.322	7.662	4.696	11.330	0.629	0.426	0.793
280	0.737	0.614	0.831	15.134	10.596	19.923	7.317	4.213	9.831	0.445	0.329	0.571
281	0.695	0.567	0.749	7.587	5.772	12.555	2.474	1.818	3.515	0.538	0.445	0.626
285	0.803	0.737	0.986	9.664	6.926	13.299	3.789	2.226	7.578	0.489	0.360	0.632
290	0.897	0.797	0.966	2.909	1.174	4.139	1.353	0.486	1.933	0.456	0.149	0.697
292	0.943	0.924	0.957	0.434	0.318	0.513	0.234	0.174	0.295	0.229	0.040	0.709

Table 4-31 continued

296	0.905	0.790	0.941	1.785	1.215	2.201	0.893	0.453	1.217	0.741	0.518	0.971
297	0.716	0.599	0.808	7.657	6.439	9.169	3.218	2.333	4.233	0.581	0.480	0.668
298	0.937	0.920	0.964	2.739	1.481	3.367	1.330	0.664	1.636	0.556	0.491	0.618
300	0.913	0.853	0.951	1.083	0.913	1.282	0.615	0.346	0.858	0.274	0.120	0.422
301	0.939	0.895	0.966	0.655	0.484	0.803	0.504	0.260	0.697	0.291	0.146	0.392
303	0.751	0.695	0.806	5.694	4.975	6.845	1.835	1.496	2.290	0.547	0.355	0.779
304	0.925	0.831	0.961	2.739	2.184	4.298	1.103	0.985	1.304	0.357	0.139	0.768
305	0.940	0.640	0.972	1.559	1.166	4.278	1.380	0.868	1.978	0.299	0.188	0.513
307	0.943	0.917	0.953	1.062	0.619	1.663	0.655	0.290	0.927	0.294	0.102	0.460
309	0.819	0.347	0.960	2.129	1.420	2.520	0.738	0.310	1.036	0.583	0.502	0.688
311	0.593	0.457	0.745	25.530	17.092	38.646	11.360	6.635	18.961	0.628	0.480	0.740
312	0.841	0.799	0.876	2.708	1.587	4.662	0.947	0.728	1.235	0.643	0.429	0.868
315	0.951	0.939	0.960	0.983	0.574	1.308	0.536	0.227	0.842	0.525	0.310	0.682
316	0.754	0.660	0.857	2.477	2.010	3.325	0.883	0.612	1.126	0.540	0.223	0.896
317	0.823	0.753	0.922	3.353	2.025	4.175	1.327	0.907	1.720	0.684	0.586	0.747
318	0.898	0.871	0.919	3.107	2.794	3.531	1.554	1.213	1.882	0.276	0.173	0.376
322	0.867	0.740	0.981	0.117	0.057	0.203	0.058	0.049	0.065	0.172	0.078	0.325
323	0.935	0.922	0.949	1.323	1.096	1.670	0.770	0.443	1.210	0.041	0.002	0.148
325	0.926	0.899	0.953	1.274	1.188	1.456	0.700	0.427	0.909	0.452	0.186	0.690
327	0.847	0.815	0.859	5.264	4.699	5.886	1.941	1.636	2.423	0.271	0.174	0.433
328	0.720	0.657	0.845	12.811	9.541	16.072	6.175	4.165	7.766	0.646	0.560	0.734
331	0.840	0.775	0.933	4.064	0.947	8.726	1.477	0.333	3.165	0.487	0.342	0.619
333	0.798	0.601	0.891	2.583	2.049	3.621	0.946	0.600	1.441	0.442	0.336	0.563
335	0.716	0.617	0.805	6.854	4.795	9.742	3.049	1.366	5.585	0.428	0.333	0.638
337	0.891	0.826	0.950	3.488	1.404	5.741	1.447	0.427	2.300	0.299	0.216	0.452
340	0.890	0.890	0.890	3.712	3.712	3.712	1.632	1.632	1.632	0.237	0.237	0.237
342	0.936	0.761	0.959	0.745	0.613	1.017	0.373	0.305	0.534	0.116	0.078	0.173
349	0.855	0.794	0.913	4.236	2.145	6.018	1.447	0.962	2.197	0.589	0.400	0.780
356	0.935	0.927	0.943	0.040	0.037	0.043	0.012	0.011	0.013	0.071	0.038	0.103

Table 4-31 continued

357	0.206	0.190	0.221	1336.339	1138.101	1564.959	365.966	238.969	524.433	0.671	0.645	0.711
358	0.936	0.891	0.962	1.609	0.926	2.311	0.850	0.456	1.377	0.618	0.327	0.904
372	0.764	0.657	0.836	8.774	7.084	10.848	4.555	3.368	6.317	0.507	0.444	0.587
373	0.653	0.595	0.722	7.325	6.268	9.323	2.784	2.438	3.698	0.509	0.440	0.581
376	0.851	0.614	0.911	4.178	3.756	4.978	1.721	1.625	1.821	0.546	0.497	0.581
377	0.655	0.548	0.839	22.626	14.109	31.505	8.242	4.775	13.707	0.760	0.662	0.927
379	0.873	0.823	0.944	3.401	2.881	3.842	1.299	1.059	1.674	0.238	0.192	0.340
381	0.530	0.428	0.631	51.250	25.478	77.023	20.707	10.641	30.774	0.503	0.492	0.513
397	0.980	0.980	0.980	0.983	0.983	0.983	0.255	0.255	0.255	0.600	0.600	0.600
402	0.853	0.785	0.922	4.278	3.042	5.513	1.881	1.802	1.960	0.307	0.230	0.384
409	0.924	0.922	0.926	3.937	3.837	4.038	1.638	1.583	1.694	0.446	0.432	0.460
415	0.257	0.209	0.325	207.835	184.222	232.295	10.825	6.281	15.308	0.342	0.206	0.523

Table 4-32. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Farm Petroleum Co-operative Firms over the Period 1984-2001

Petroleum	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
14	0.9576	0.9294	0.9750	2.0760	1.6650	2.5324	0.6139	0.4359	0.8166	0.5907	0.2253	0.8558
62	0.9742	0.9676	0.9802	0.6406	0.5618	0.7546	0.2975	0.2169	0.3514	0.1520	0.0499	0.3156
168	0.7067	0.6926	0.7341	12.0434	8.2806	19.7134	2.7424	1.7758	4.1421	0.0981	0.0591	0.1573
203	0.9388	0.9208	0.9500	2.9900	1.8150	4.3553	1.2393	0.5606	1.8633	0.5585	0.2541	0.7147
204	0.7610	0.6078	0.8774	29.7307	11.7386	58.7259	11.8544	3.8873	22.8627	0.7356	0.4588	0.9844
208	0.7747	0.7645	0.7876	12.3379	9.4436	14.7764	3.5005	2.3476	4.2924	0.6074	0.5146	0.6420
210	0.8153	0.7525	0.8575	11.4081	5.7880	22.1439	4.6528	1.8190	8.8623	0.6136	0.5147	0.7687
220	0.8415	0.7118	0.9662	12.7512	5.9474	24.6650	4.5638	1.8835	9.4272	0.3320	0.1091	0.5635
225	0.9378	0.8976	0.9606	2.8040	1.7058	5.6642	1.7658	0.9832	3.3373	0.3254	0.0885	0.7893
228	0.7859	0.6751	0.9886	16.4320	11.3057	21.8219	6.5800	3.4587	9.1767	0.5157	0.3155	0.7262
234	0.9111	0.8709	0.9385	3.3165	2.6432	4.3384	1.2906	1.0437	1.7406	0.3074	0.2057	0.4457
270	0.9417	0.8010	0.9736	0.9303	0.4509	1.6306	0.5587	0.2235	1.0475	0.3118	0.1579	0.4555

Table 4-32 continued

272	0.9314	0.8412	0.9540	2.7193	1.3551	6.8053	1.2783	0.6374	2.8873	0.4139	0.1579	0.5708
273	0.8980	0.7606	0.9423	3.7370	2.3011	6.3779	1.3420	0.6958	2.5740	0.4852	0.3207	0.5895
274	0.8712	0.8170	0.9082	8.5476	7.0649	11.2548	4.5397	3.4904	6.0301	0.4766	0.4076	0.5589
282	0.7497	0.6716	0.8070	18.9961	11.0417	34.3695	7.1934	3.2843	14.3428	0.5315	0.4185	0.7547
286	0.9753	0.9647	0.9821	0.6888	0.5762	0.9563	0.3030	0.2088	0.3401	0.0340	0.0018	0.0988
288	0.8799	0.8385	0.9339	6.3924	3.6570	9.8071	2.4142	1.0362	3.8375	0.5687	0.3630	0.7997
289	0.9516	0.9328	0.9620	2.3086	1.5089	4.3723	0.9289	0.5432	1.8663	0.2334	0.1475	0.2977
291	0.9523	0.9084	0.9714	0.4921	0.3172	0.7070	0.1941	0.1443	0.2689	0.3874	0.2461	0.5285
293	0.9325	0.8989	0.9618	2.3742	1.2148	3.9145	0.9348	0.4468	1.5095	0.4687	0.2724	0.6805
294	0.9320	0.8168	0.9611	2.7387	1.5109	7.6051	1.1604	0.4848	2.3236	0.4368	0.1276	0.6574
295	0.6042	0.5480	0.6600	66.6318	33.3321	101.1353	32.5494	13.9277	53.8768	0.7187	0.5684	0.8171
306	0.9589	0.9163	0.9778	2.9024	2.1921	4.6243	2.0248	1.1673	4.1021	0.5264	0.3056	0.6789
308	0.7778	0.6576	0.9906	6.7211	2.4684	17.4872	1.4238	0.4116	5.4728	0.5167	0.2468	0.6935
310	0.6614	0.6237	0.7147	32.2291	20.7061	51.7703	11.5579	5.3880	18.1456	0.5333	0.4033	0.6652
313	0.5794	0.4628	0.7891	68.5784	46.0923	105.9763	23.5732	14.4406	40.5325	0.6457	0.5711	0.8246
314	0.9517	0.9325	0.9656	0.2277	0.1928	0.3052	0.0730	0.0595	0.0873	0.0787	0.0279	0.1863
320	0.9640	0.9423	0.9769	0.7976	0.6372	1.0231	0.3675	0.2730	0.4965	0.1535	0.0582	0.3254
321	0.7262	0.6848	0.8101	13.9335	9.3325	21.3125	5.6775	2.7273	13.2534	0.4202	0.2106	0.6949
324	0.9009	0.8428	0.9804	5.2769	2.0201	6.5452	2.7059	1.8691	3.7932	0.4158	0.3246	0.5410
330	0.9363	0.8926	0.9617	2.2712	1.5326	3.1288	1.0117	0.4806	1.4460	0.3641	0.1597	0.5472
332	0.9006	0.8141	0.9617	2.7320	1.6240	5.1337	1.1278	0.8229	1.6055	0.2527	0.1156	0.3461
334	0.6277	0.5974	0.6755	47.9015	37.2415	72.2330	20.5707	15.2606	32.0376	0.5639	0.5183	0.6446
336	0.8406	0.7625	0.9268	7.9127	5.9678	10.1643	3.0671	2.4172	4.3543	0.4063	0.3156	0.6056
338	0.9471	0.9197	0.9605	2.7650	1.8941	3.5690	1.3331	0.8277	1.7939	0.4625	0.2539	0.6287
341	0.9295	0.9064	0.9524	3.4244	2.4336	4.4183	1.4570	0.8265	2.5809	0.3003	0.1770	0.4890
368	0.8845	0.8356	0.9132	6.8219	4.9094	8.8278	2.5163	1.6488	3.8653	0.5434	0.4428	0.6214
382	0.6341	0.5857	0.6824	32.8135	17.8576	47.7694	13.7549	6.2723	21.2376	0.4467	0.3625	0.5310
390	0.7750	0.7444	0.8276	11.3114	6.6695	17.2140	3.0329	1.5865	5.2475	0.5645	0.4875	0.6195
400	0.7019	0.6913	0.7125	27.4217	26.5434	28.3000	8.0126	7.7842	8.2409	0.5502	0.5452	0.5551

Table 4-33. A Summary of Average Efficiency, Sales, Assets and Debt to Asset Ratio for Individual Feed Mill Co-operative Firms over the Period 1984-2001

Feed Mill	Efficiency			Sales (million $)			Assets (Million $)			Debt to Asset ratio		
Firm	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum	Mean	Minimum	Maximum
1	0.621	0.472	0.709	3.190	2.051	6.252	1.761	0.666	3.615	0.210	0.105	0.561
3	0.848	0.771	0.886	1.921	1.674	2.337	1.824	1.167	2.229	0.098	0.034	0.218
27	0.442	0.360	0.525	6.226	3.696	9.895	2.923	1.345	4.374	0.060	0.020	0.097
30	0.017	0.011	0.026	446.787	252.952	838.895	152.062	80.439	266.776	0.306	0.135	0.438
39	0.932	0.813	0.984	0.764	0.410	1.080	0.354	0.244	0.549	0.618	0.444	0.855
40	0.843	0.758	0.893	1.671	1.263	2.702	0.780	0.547	1.404	0.152	0.058	0.338
41	0.687	0.564	0.876	2.473	1.709	3.140	1.150	0.978	1.295	0.130	0.036	0.221
44	0.675	0.655	0.700	3.178	2.373	3.742	1.934	1.877	2.009	0.200	0.172	0.235
45	0.580	0.476	0.672	3.560	2.674	6.264	1.693	1.096	2.657	0.443	0.060	0.656
48	0.427	0.410	0.452	6.173	5.726	6.581	2.750	2.456	3.006	0.162	0.140	0.195
49	0.335	0.179	0.505	10.972	3.954	29.005	6.373	1.934	14.248	0.216	0.133	0.358
50	0.948	0.928	0.964	0.947	0.900	1.047	0.319	0.314	0.326	0.529	0.513	0.545
52	0.497	0.367	0.692	5.250	2.528	9.270	2.702	1.233	4.104	0.181	0.020	0.361
57	0.985	0.981	0.987	0.299	0.210	0.500	0.086	0.062	0.142	0.229	0.081	0.549
61	0.487	0.320	0.712	5.468	2.174	11.917	2.351	0.570	5.302	0.236	0.022	0.970
66	0.945	0.891	0.966	1.027	0.831	1.437	0.716	0.698	0.750	0.015	0.014	0.019
67	0.894	0.848	0.936	1.378	1.070	1.900	0.799	0.464	0.999	0.042	0.002	0.166
68	0.919	0.881	0.956	1.245	0.864	1.660	0.694	0.401	0.952	0.032	0.007	0.087
69	0.927	0.872	0.967	1.105	0.602	1.835	0.491	0.209	0.849	0.089	0.007	0.202
70	0.779	0.680	0.867	2.066	1.489	3.503	1.392	0.749	2.057	0.025	0.005	0.060
71	0.874	0.838	0.911	1.525	1.319	1.925	0.955	0.636	1.263	0.081	0.006	0.235
72	0.896	0.773	0.955	1.355	0.790	2.348	0.810	0.534	1.563	0.060	0.024	0.179
73	0.857	0.815	0.918	1.720	1.459	1.922	1.007	0.745	1.251	0.035	0.010	0.101
74	0.920	0.889	0.942	1.275	1.054	1.907	0.948	0.785	1.138	0.123	0.090	0.174
75	0.806	0.742	0.873	1.909	1.548	2.139	1.144	0.965	1.345	0.051	0.021	0.105
76	0.979	0.969	0.986	0.269	0.227	0.299	0.163	0.128	0.199	0.014	0.004	0.026
77	0.711	0.569	0.986	2.953	1.537	4.491	1.899	0.631	3.056	0.005	0.000	0.017
78	0.718	0.614	0.978	2.773	2.009	3.501	1.491	0.935	2.152	0.110	0.066	0.197

Table 4-33 continued

79	0.944	0.909	0.962	1.023	0.908	1.140	0.756	0.612	0.864	0.060	0.006	0.115
80	0.884	0.824	0.937	1.490	1.159	1.735	0.793	0.471	1.143	0.106	0.008	0.311
82	0.811	0.653	0.895	1.905	1.416	3.691	1.194	0.584	2.031	0.040	0.002	0.217
83	0.934	0.898	0.965	1.110	0.855	1.493	0.781	0.532	0.988	0.091	0.013	0.288
84	0.964	0.944	0.978	0.748	0.461	1.266	0.482	0.239	0.726	0.053	0.003	0.153
85	0.753	0.648	0.924	2.232	1.201	3.426	1.339	0.533	2.246	0.087	0.015	0.237
86	0.968	0.953	0.978	0.736	0.635	0.813	0.582	0.554	0.604	0.030	0.014	0.044
87	0.836	0.685	0.924	1.768	1.160	3.236	1.011	0.410	1.826	0.049	0.019	0.116
88	0.919	0.867	0.944	1.261	1.018	2.047	0.838	0.385	1.454	0.039	0.006	0.149
89	0.611	0.544	0.714	3.278	2.247	4.994	2.007	1.094	2.887	0.056	0.012	0.147
90	0.970	0.965	0.977	0.720	0.592	0.847	0.472	0.443	0.497	0.066	0.020	0.119
91	0.713	0.649	0.760	2.618	2.424	2.877	1.456	1.406	1.537	0.033	0.012	0.076
92	0.690	0.612	0.856	2.745	1.581	4.142	2.069	0.794	3.330	0.021	0.003	0.102
93	0.836	0.836	0.836	2.328	2.328	2.328	1.372	1.372	1.372	0.009	0.009	0.009
94	0.982	0.980	0.984	0.283	0.278	0.290	0.140	0.130	0.157	0.048	0.017	0.065
96	0.641	0.543	0.761	2.881	2.447	3.247	1.809	1.358	2.195	0.247	0.010	0.620
97	0.866	0.775	0.932	1.566	1.100	2.184	0.900	0.513	1.168	0.051	0.020	0.077
98	0.921	0.885	0.987	1.265	1.067	1.531	0.947	0.496	1.187	0.024	0.003	0.110
99	0.969	0.954	0.979	0.604	0.443	0.830	0.424	0.307	0.517	0.046	0.008	0.150
100	0.744	0.679	0.823	2.381	2.193	2.695	1.386	1.195	1.550	0.045	0.009	0.102
101	0.971	0.968	0.974	0.487	0.452	0.519	0.278	0.234	0.319	0.230	0.087	0.307
102	0.786	0.614	0.987	2.095	1.509	4.144	1.194	0.625	2.209	0.139	0.007	0.253
103	0.866	0.334	0.972	1.593	0.579	7.687	0.716	0.273	1.337	0.123	0.028	0.223
104	0.850	0.788	0.922	1.729	1.475	1.927	1.033	0.841	1.182	0.047	0.011	0.101
105	0.942	0.928	0.964	1.035	0.797	1.311	0.666	0.422	0.809	0.039	0.003	0.101
106	0.955	0.931	0.968	0.893	0.577	1.181	0.501	0.318	0.663	0.065	0.011	0.335
107	0.969	0.958	0.976	0.468	0.328	0.761	0.106	0.072	0.147	0.190	0.099	0.299
108	0.925	0.875	0.967	1.232	0.755	1.979	0.821	0.381	1.261	0.006	0.001	0.021
109	0.911	0.834	0.954	1.215	0.918	1.501	0.720	0.386	0.904	0.106	0.018	0.217
110	0.978	0.972	0.983	0.442	0.365	0.535	0.315	0.201	0.383	0.035	0.008	0.184
111	0.945	0.376	0.985	0.758	0.330	4.830	0.580	0.401	0.810	0.067	0.013	0.194
112	0.916	0.864	0.958	1.095	0.896	1.330	0.756	0.703	0.811	0.138	0.047	0.284

Table 4-33 continued

113	0.858	0.783	0.934	1.653	0.963	2.473	0.899	0.390	1.247	0.092	0.014	0.372
114	0.957	0.947	0.967	1.025	1.021	1.028	0.670	0.587	0.754	0.066	0.031	0.102
115	0.355	0.300	0.407	8.528	6.240	9.767	4.406	3.264	5.932	0.360	0.296	0.477
116	0.918	0.881	0.952	1.298	0.910	1.678	0.796	0.459	1.093	0.091	0.013	0.268
117	0.941	0.880	0.964	1.021	0.698	1.809	1.186	0.332	9.200	0.025	0.004	0.111
118	0.591	0.512	0.727	3.555	2.014	5.067	2.249	1.211	3.166	0.178	0.061	0.306
119	0.941	0.888	0.975	1.069	0.532	1.450	0.671	0.295	1.050	0.097	0.016	0.177
120	0.852	0.655	0.956	1.668	0.851	3.585	0.918	0.397	1.602	0.020	0.004	0.075
121	0.968	0.959	0.974	0.661	0.591	0.750	0.435	0.396	0.494	0.100	0.003	0.279
122	0.911	0.835	0.946	1.218	0.916	1.595	0.841	0.465	1.131	0.095	0.025	0.295
123	0.643	0.446	0.854	3.158	1.548	6.662	1.540	0.659	2.939	0.073	0.009	0.246
124	0.970	0.945	0.987	0.610	0.449	0.853	0.360	0.233	0.424	0.085	0.015	0.335
125	0.940	0.918	0.959	1.119	0.884	1.332	0.825	0.382	1.278	0.047	0.005	0.146
126	0.673	0.620	0.784	2.673	1.979	3.518	1.692	0.912	2.172	0.101	0.028	0.197
127	0.964	0.952	0.976	0.771	0.669	0.866	0.418	0.289	0.540	0.022	0.003	0.121
128	0.831	0.694	0.987	1.825	1.026	3.324	1.054	0.523	1.707	0.052	0.009	0.186
129	0.759	0.711	0.822	2.088	1.733	2.505	1.410	0.555	1.996	0.106	0.043	0.206
130	0.915	0.775	0.975	1.168	0.529	2.226	0.665	0.301	1.035	0.161	0.028	0.284
131	0.483	0.359	0.601	4.970	2.938	9.795	2.365	1.061	4.358	0.241	0.050	0.456
132	0.568	0.535	0.602	3.637	2.973	4.645	1.799	1.439	2.131	0.065	0.014	0.123
133	0.954	0.659	0.979	0.614	0.441	0.887	0.430	0.251	0.626	0.028	0.003	0.128
134	0.976	0.971	0.982	0.440	0.334	0.563	0.164	0.114	0.224	0.034	0.007	0.094
135	0.606	0.563	0.648	3.395	3.204	3.675	2.107	1.972	2.385	0.146	0.040	0.210
137	0.955	0.898	0.973	0.920	0.596	1.870	0.640	0.294	1.103	0.055	0.000	0.119
138	0.893	0.792	0.958	1.410	0.832	2.159	0.707	0.358	0.977	0.092	0.026	0.233
139	0.944	0.904	0.969	1.007	0.812	1.227	0.625	0.426	0.790	0.076	0.013	0.283
140	0.853	0.805	0.904	1.652	1.212	2.166	1.020	0.572	1.469	0.092	0.018	0.171
141	0.918	0.872	0.959	1.259	0.812	1.832	0.916	0.537	1.518	0.038	0.009	0.156
142	0.910	0.811	0.961	1.248	1.081	1.635	1.084	0.980	1.209	0.159	0.107	0.255
143	0.954	0.935	0.972	0.888	0.620	1.235	0.455	0.272	0.579	0.082	0.013	0.191
144	0.947	0.880	0.965	0.976	0.684	1.448	0.623	0.355	0.831	0.053	0.008	0.231
145	0.891	0.817	0.942	1.461	1.052	2.288	1.020	0.606	1.359	0.040	0.004	0.087

Table 4-33 continued

146	0.921	0.875	0.987	1.306	0.864	1.956	0.731	0.450	1.107	0.064	0.008	0.219
147	0.963	0.952	0.974	0.796	0.565	1.090	0.477	0.236	0.668	0.059	0.007	0.139
149	0.773	0.557	0.933	2.165	0.939	4.524	1.128	0.410	1.983	0.104	0.032	0.266
150	0.833	0.751	0.939	1.745	0.982	2.364	1.061	0.416	1.525	0.069	0.007	0.176
151	0.839	0.776	0.916	1.743	1.183	2.235	1.050	0.502	1.388	0.055	0.006	0.154
152	0.751	0.537	0.912	2.402	1.009	5.065	1.111	0.446	2.604	0.083	0.010	0.271
153	0.753	0.612	0.853	2.038	1.488	2.789	1.245	0.904	1.604	0.163	0.018	0.466
154	0.550	0.464	0.631	3.870	2.768	6.216	2.234	1.251	3.496	0.117	0.012	0.229
155	0.765	0.686	0.820	2.276	1.815	3.432	1.234	0.995	1.520	0.042	0.039	0.062
156	0.662	0.559	0.816	2.786	1.716	3.727	1.616	0.724	2.272	0.124	0.056	0.240
158	0.595	0.522	0.728	3.439	2.186	4.738	2.164	0.994	3.093	0.131	0.007	0.440
159	0.981	0.981	0.981	0.459	0.459	0.459	0.149	0.149	0.149	0.647	0.647	0.647
163	0.985	0.985	0.985	0.013	0.013	0.013	0.015	0.015	0.015	0.070	0.070	0.070
172	0.609	0.400	0.763	3.411	1.952	6.253	2.133	1.032	3.787	0.095	0.010	0.260
174	0.765	0.565	0.931	2.334	1.052	4.827	1.218	0.491	2.428	0.104	0.019	0.474
176	0.810	0.744	0.867	1.679	1.421	1.906	0.709	0.558	0.834	0.226	0.145	0.302
177	0.826	0.706	0.964	1.788	0.670	3.001	1.076	0.315	2.022	0.120	0.013	0.349
180	0.341	0.155	0.575	12.337	3.196	35.169	6.158	1.654	15.530	0.089	0.008	0.242
183	0.902	0.839	0.967	1.302	0.665	1.928	0.776	0.292	1.255	0.345	0.216	0.538
193	0.631	0.506	0.853	3.246	1.481	5.074	1.060	0.379	1.801	0.067	0.006	0.347
209	0.930	0.915	0.957	1.059	0.815	1.220	0.357	0.301	0.447	0.352	0.267	0.454
347	0.651	0.578	0.723	2.741	2.292	3.216	1.082	0.924	1.162	0.234	0.154	0.323
361	0.573	0.520	0.724	3.130	2.499	3.652	0.530	0.456	0.614	0.186	0.132	0.320

Table 4-34: Random Parameter Tobit Regression Parameters Estimates for Farm Supply, Feed Mills, and Farm Petroleum Co-operatives in Canada, 1984 - 2001

	Farm Supply		Feed Mills		Farm Petroleum	
Constant	0.888***	(0.002)	0.905***	(0.002)	1.140***	(0.001)
Std. Deviation of Constant	0.050***	(0.001)	0.059***	(0.001)	0.349***	(0.002)
Mean of Sales	-0.072***	(0.001)	-0.136***	(0.003)	-0.203***	(0.001)
Std. Deviation of Sales	0.008***	(0.0004)	0.027***	(0.001)	0.206***	(0.001)
Mean of Sales^2	0.002***	(0.0001)	0.011***	(0.001)	0.003***	(0.001)
Std Deviation of Sales^2	0.026***	(0.001)	0.003***	(0.0004)	0.003***	(0.001)
Mean of Debt/Asset ratio	-0.136***	(0.004)	0.039***	(0.004)	-0.021***	(0.005)
Std. Deviation of Debt/Asset ratio	0.171***	(0.003)	0.062***	(0.002)	0.157***	(0.004)
σ	0.061***	(0.0003)	0.034***	(0.0002)	0.041***	(0.0001)
LLF	1588.541		1112.830		2428.922	
Chi squared	3177.083		2225.660		4857.844	
Firms	93		42		115	
Firms x Time	1293		619		1599	

Note: *, **, *** refers to 10 per cent, 5 per cent and 1 per cent, respectively, level of significance.
Figures in bold are posterior standard deviations of the random parameters.
Figures in parentheses are standard deviations

Table 4-35: The Degree of Correlation between Profitability and Cost Efficiency for Selected Agribusiness Co-operatives in Canada

	Profitability (ROA)		Cost Efficiency (CE)		Correlation
Co-operative Activity	Mean		Mean		$\rho_{(ROA, CE)}$
Dairy	0.058	(0.095)	0.746	(0.120)	0.192
Grains and Oilseeds	0.019	(0.105)	0.839	(0.085)	0.095
Fruit and Vegetable	0.052	(0.169)	0.720	(0.117)	0.059
Honey and Maple	0.038	(0.073)	0.853	(0.073)	0.313
Farm Supply	0.070	(0.083)	0.778	(0.169)	-0.075
Feed Mills	0.068	(0.059)	0.854	(0.120)	-0.083
Farm Petroleum	0.131	(0.073)	0.802	(0.188)	-0.230

Figures in Parenthesis are standard deviations.

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Chapter 5: Summary, Conclusions, and Policy Recommendations

The underlying rational for the formation of co-operatives is to improve the welfare of its members and the society. Co-operatives have a rich history of empowering people, providing needed services in isolated communities, and finding unique solutions for many economic and social problems. Co-operatives exist to provide economic services to its members rather than just to generate a return on investment. Although there can be social, political and cultural reasons for forming a co-operative, co-operatives have been started for one or more of the following reasons: (i) to improve the bargaining power of farmers when dealing with other businesses; (ii) to reduce costs of production; (iii) to obtain products or services otherwise unavailable; (iv) to obtain market access or broaden market opportunities; (v) to improve product or service quality; and (vi) to increase farmers' income.

Co-operatives comprise an important part of the overall agricultural sector in Canada. However, co-operatives' market share has plummeted precipitously in most sectors over the past decade. For example, the market share for dairy co-operatives dropped from a high of 59 per cent in 1991 to 42 per cent in 2001; for grain co-operatives, 74 per cent to 45 per cent in the same time period. This generates situations where markets are heavily concentrated at the hands of a few multinational private companies. The leading firms in concentrated markets may engage in strategic conduct intended to retain, entrench and expand their positions which may impose significant economic and social costs on both farmers and consumers. Such conduct may not promote economic efficiency or positive dynamic change in the market place. The key issue is the trend towards consolidation and vertical co-ordination of agri-food chains, whereby key agents such as a food processor or retailer sets the rules of the game for participating in the chains. The rapid consolidation within the agriculture sector, which puts a premium on economies of scale, is particularly troubling because it may lead to only a few firms to control the processing and retailing sectors. On the other hand, vertical co-ordination may lead to closed markets where prices are fixed not by competitive bidding, but by negotiated contracts, where primary producers who do not produce in large volumes are discriminated against in price or other terms of trade. Under these market situations, many smaller farmers may be forced out of their business because they may not have a place to sell their product in a timely manner at a fair price. Vertical co-ordination gives great power to those firms coordinating the particular commodity chain. This power can override market-based transactions, with big implications for pricing and the wholesale market. The end result is farmers may receive only a tiny percentage of the price of retailed products, with the vast bulk of the profits going to processors and retailers. The outcomes in such a situation are significant from societal welfare point of view. Research to avoid more of the above shed light on potential problem areas.

The overall purpose of this study is to provide a better understanding of the relationship between debt leverage and performance for agricultural supply and marketing co-operatives in Canada. The question of capital constraints for agricultural co-operative businesses has attracted much attention from co-operative members, managers, governments, academics, and others in recent years. Among the most cited literature is the impact that globalization, market deregulation, and consumer concerns for food safety impose on traditional co-operative structures and their consequences on capital expenditure requirements. An important question addressed in this study is whether capital structure of the co-operative firm affects its performance. Previous research has tested the relationship between leverage and costs of production (Kim and Maksimovic, 1990; Featherstone and Al-Kheraiji, 1995) or the degree of leverage and productivity (Hossain and Jain, 2001; Bernstein and Nadiri, 1993) by examining the effects of long term debt on total variable costs/productivity. These studies have invariably concluded that debt leverage has negatively affected total variable costs/ productivity.

In this research analysis is conducted to explore the impact of capital constraints (i.e., capital structure) on Canadian agribusiness co-operatives members' welfare. The specific objectives of the study include the following: (i) to determine if there are agency costs of debt and to scrutinize the impact of agency costs of debt on variable costs of production for five cases of Western Canadian co-operatives; (ii) to explore the impact of differing attitudes towards debt financing on the welfare of co-operative members; and (iii) to assess the efficiency of Canadian agribusiness supply and marketing co-operatives and investigate factors that may influence their level of efficiency. In general, the empirical results in this study indicate that co-operative performance is impacted by the degree of financial leverage. These empirical results are robust across the three papers. In this chapter, a summary of key findings, conclusions, policy recommendations, and future research recommendations is presented.

5.1 Summary and Conclusions

The objective of Chapter 2 is to investigate the potential impact of agency costs of debt on variable costs of production for five cases of Western Canadian agricultural supply and marketing co-operatives. In order to explore the impact of agency costs of debt on the costs of production, cost functions are estimated in which long term debt is defined as a shift variable in the production function through its impact on managerial efforts. Data are obtained for five case co-operative firms for the period 1974-2001 from annual reports and Statistics Canada data series. Using these data, a separate Translog cost function is estimated for each co-operative.

The results indicate that the existence of agency costs of debt may be contingent on the co-operative structure (i.e., supply vs. marketing co-operatives) and the industry regulatory environment (i.e., supply managed industries vs. non-supply managed industries). As an illustration, a 10 per cent increase in the level of debt capital results in a 0.67 per cent increase in the variable costs of processing and marketing honey for Alberta Honey Producers Co-operative Ltd (Table 5-1). Agency costs of this magnitude would certainly be an important determinant of the firm's capital structure decision (Mello and Parsons, 1992). In light of these results it is important to take into account the possible agency costs of debt and those factors aggravating them when undertaking capital investment in agribusiness co-operatives. However, since this is a comparative case study, the findings may not necessarily generalize to other co-operatives.

In Chapter 3, the objective of the study is to assess the degree of difference in risk attitudes between managers and directors and the impact of any differences on co-operatives' performance. Specifically, Chapter 3 focuses on the measurement of risk attitudes for managers and directors, and the impacts that differing risk attitudes might have on the welfare of agribusiness co-operative members. A survey of co-operative managers and directors was conducted to collect information regarding decision makers' risk attitudes, risk management practices and awareness, general business information and demographic characteristics. Thirty survey questionnaires were returned for a response rate of approximately 20 percent[1].

Based on Fisher's Exact test and the Mann-Whitney U Test, there appear to be significant differences in risk attitudes between managers and directors of agribusiness co-operatives. Results from an ordered probit model suggest that those respondents with favourable attitudes towards long-term borrowing and those who are frequent gamblers are more likely to intend to increase long-term borrowing for business expansion.

To further explore the potential impacts of divergence in risk attitudes on firm performance, an illustrative analytical hierarchy simulation analysis is developed. Results from this analysis indicate that differing risk attitudes may have an important economic impact on financial risk exposure and members' welfare (Table 5-2). However, this impact may depend on the distribution of decision-making power between the managers and the directors. Hence, observed capital structure in agribusiness co-operatives may partially depend on decision makers' risk attitudes, the divergence in decision makers' risk attitudes, and on their relative decision-making power. Another implication of these results is that decision makers' attitudes towards debt and their knowledge of risk management strategy may affect corporate financial risk management policy. The differing attitudes towards increasing debt capital between managers and directors may increase agency cost problems due to the costs associated with resolving conflicts (e.g., wasted time). Indeed, Jensen and Meckling (1976) acknowledge that it is too costly to align the interests of owners and management perfectly. It should be noted that the simulation analysis is done for illustrative purposes only. As a consequence, results should be considered with care as further empirical analysis is needed to evaluate the importance of differing risk attitudes and decision making power.

The objective of Chapter 4 is to measure the efficiency of supply and marketing co-operatives and to scrutinize the impacts of financial leverage and firm size on efficiency. Unbalanced panel data over the period 1984 to 2001 are obtained from the annual survey of co-operatives in Canada that is conducted by the Canadian Co-operative Secretariat. Translog random parameter stochastic cost frontiers are estimated separately for dairy, grain and oil, fruit and vegetable, farm supply, farm petroleum, and feed mills co-operatives; a Cobb-Douglas random parameters stochastic cost frontier is estimated for honey and maple co-operatives.

Random parameter stochastic frontier models are used to distinguish cost inefficiency from technological differences across firms in the same industry. The random parameter stochastic frontier model controls for the latent heterogeneity in technology across firms in the same industry. It is found that the unobserved technological heterogeneity among firms in the same industry matters in the estimation of firm level cost efficiency. This suggests that the estimated cost efficiencies depend on whether or not the unobserved technological differences are accounted for in the analysis. Thus, the random parameters stochastic frontier estimation method can generate results that better reflect technological heterogeneity.

Based on the results from the random parameter stochastic frontier model, it is evident that there are cost inefficiencies for firms in the industries under investigation

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[1] The overall response rate considering the intial contacts was much lower.

(Table 5-3). For example, dairy marketing co-operative costs could have been reduced by approximately 25 per cent had the co-operatives been operating on the cost frontier. For honey marketing and farm input supply co-operatives, the potential cost savings was approximately 15 per cent. Accordingly, improved cost efficiency may be one avenue for co-operative businesses to explore in order to insulate themselves from increasing competitive rivalry.

Finally, a random parameter Tobit regression is estimated to scrutinize factors affecting cost efficiency. Debt leveraging has a negative effect on cost efficiency of co-operative firms in all industries investigated, with the exception of co-operatives in the feed mill industry. These results are generally consistent with previous studies that found a negative association between financial leverage and firm performance (Jensen and Meckling, 1976; Nasr et al., 1998; Rajan and Zingales, 1995; Johnson, 1997; Michaelas et al., 1999). For example, Rajan and Zingales (1995) and Michaelas et al. (1999) found a negative relationship between financial leverage and profitability. Opler and Timan (1994) as well showed that highly leveraged firms suffer from a competitive disadvantage due to significant indirect costs of financial distress, and the adverse consequences of leverage are more pronounced in concentrated industries. In addition, their results indicated that cost decreases with increased use of equity for mutual thrifts, which is consistent with the results in this study.

In sum, in this study an empirical investigation of capital constraints and financial leverage in Canadian agribusiness supply and marketing co-operatives is conducted from three different perspectives using alternative methodologies and data sets. The overall conclusion is that co-operative performance is affected by the degree of financial leverage. The basic implication of this study is that within a specific industry (i.e., common production technology) and within a common institutional environment, the degree of financial leverage and performance may be linked through a trade-off between tax and other benefits and default (agency) costs of debt.

There are four question addressed in this study. Since co-operatives are facing capital constraints, the first question examined the impacts of excessive debt on agribusiness co-operative performance. Various sources of data from different co-operatives are used to illustrate that the impact of debt leverage is unique both across industries and across individual firms within the same industry. In general, results from the three independent studies suggested that debt had impacts on the performance of the firm.

The second research question explored whether supply and marketing co-operatives are equally affected by the issues around capital constraints. The results showed that the effect of agency costs of debt on firm performance is more pronounced for the marketing co-operatives. In addition, resulted indicated that agency costs of debt are higher in unregulated industries and are modest or absent under regulated environments. For example, it appears that the marketing co-operatives have historically been involved in intensive investment in plant upgrading, automation and purchases which might have resulted in investment in negative value projects. As well, there were significant agency costs of debt for centralized co-operative (e.g., Alberta Honey Producer Co-operative) as compared to federated co-operatives structure (e.g., Federated Co-operative Limited). In general, there are distinctive differences in the impacts of financial leverage on co-operative costs of production or performance.

The third research question inquired into the effect of differing risk attitudes between managers and directors on co-operative members' welfare. The study investigated the hypothesis that managers and directors differ in their risk attitude using a mail survey. The measure of risk attitude is based on the theory of planned behaviour, stochastic dominance, and willingness to pay for a lottery. The results suggest that sample managers and directors potentially differ in their (risk) attitudes. As well, there appears to be inconsistencies across measurement methods. Directors are less inclined to engage in risk-seeking behaviour as measured by stochastic dominance, and are more inclined to exhibit risk-taking behaviour as measured by the TpB and WTP approaches. Given these differences, and the lack of a sufficiently large sample to be representative, this is an avenue for further research. From the illustrative simulation model, by comparing risk aversion coefficients with the co-operative members' welfare, it is apparent that the degree of risk aversion of decision makers may have a strong impact on firm performance. These results illustrated that the more averse decision makers are to risk, the lower the empirically determined values of members' welfare. Furthermore, the simulation results illustrated that the impacts of differences in risk attitudes may depend on the decision-making power and influence of decision makers. Because every decision makers has a unique degree of risk aversion and influence, the co-operative must try to incorporate this information into its decision process.

The final research question explored the impact of excessive debt on cost efficiency of agribusiness co-operatives firms across different industries. Data from different co-operatives were used to explore whether the impact of debt leverage will be unique both across industries. The evidence from this study suggests that there may be significant potential for reducing the cost of adding value to co-operative members' outputs and/or providing services to co-operative members without loss in value added or cutback in services provided. In terms of the impact of capital constraints on firm performance, with the exception of feed mill co-operatives, it is found that higher financial leverage had likely contributed to cost inefficiencies. Additional research is warranted to determine what is causing efficiency to vary with the degree of financial leverage.

The overall answer to the four questions raised in this dissertation is that capital constraint had affected co-operative firms. The effects, however, depends on the type of industry, co-operative structure (federated vs. centralized), co-operative type (marketing vs. supply), and co-operative size (small vs. large) and regulatory environment (regulated vs. unregulated industry).

The ability of agribusiness co-operatives to survive in the long term depends on their ability to provide satisfactory services to the member-patrons, while generating sufficient revenues to cover the costs and provide returns to members that are at least as high as they could get from other marketing alternatives. This ability is partially determined by the internal performance of the co-operative. Unless the co-operative is the most efficient alternative for its members, the organization will be prone to instability caused by loss of member support.

It is also demonstrated that the degree of financial leverage may be affected by the divergence in decision makers' degree of risk aversion and decision making power. Managers' intrinsic interests can differ from owners' interests due to differences in attitudes toward risk (e.g., Ross, 1973). The property rights and governance structure of co-operatives are also indicated as a reason for a set of problems that arise from separation of ownership and management (Vitaliano, 1983).

One of the potential disadvantages of the co-operative structure is the tendency for the horizon problem to be an issue. This limits the co-operative's ability to raise equity capital from its members for long-term investments, contributing to co-operatives being more highly leveraged. As a result, agribusiness co-operatives' ability to undertake programs to reduce costs and/or generate revenues may be limited.

Empirical evidence showed that the structure of residual claims in co-operative firms restricts capital growth (Fulton et al., 1995). Establishing a secondary market for equity capital can increase the share transferability and liquidity. According to Cook (1995), proportional shares that can be traded among members or potential members can ameliorate certain agency problems. For example, tradable shares provide members with signals for evaluating the market performance of co-operative and choosing their suitable investment portfolio. Members will have more incentives to invest in risky activities like new product development.

5.2 Policy Recommendations

Based on the findings in Chapter 2, capital expenditure decisions made by co-operatives should take into account the indirect costs associated with potential agency problems. This has been ignored in previous capital investment analysis. When agency costs of debt are present, adjustment should be made in capital budgeting process in evaluating capital investment decisions. If the agency costs of debt exist but are not included in decision-making, it may lead to overestimation of the net benefits of capital investment.

The evidence from Chapter 3 may suggest a need for technical support for co-operative decision makers in the area of financial risk management since most of the sample decision makers have limited knowledge about various types of risk management strategies. In addition, acknowledging and aligning differences in decision makers' attitudes may facilitate the optimization and achievement of overall co-operative goals. When developing risk management models, incorporating decision makers' risk attitudes may improve the "predictive power" of these models.

The findings in Chapter 4 suggest that one of the lessons from this study is that latent heterogeneity in technology across firms should be taken into account when estimating efficiency. Also, the problem related to the negative relationship between debt leverage and efficiency may be lessened by mobilizing equity capital. However, traditional co-operative agribusiness firms face difficulties in raising the equity capital necessary to finance their operations (Doyon, 2001; Chaddad, 2001). Thus, new incentive mechanisms and strategies may be required to stimulate member and community involvement to strengthen the capital base needed to compete in the market place. However, further investigation of the costs and benefits of alternative co-operative capitalization models and practices (Chaddad and Cook , 2004; Ernst and Young, 2002) in use elsewhere may be useful.

The empirical results in this study suggest that obtaining more equity capital might be a necessary condition for overcoming the capital constraint problems in agricultural co-operatives. In response to this problem, some co-operatives have been involved in mergers (e.g., Manitoba Pool Elevator and Alberta Wheat Pool), acquisitions (e.g., Saskatchewan Wheat Pool), joint ventures (e.g., Saskatchewan Wheat Pool and

James Richardson International Limited), strategic alliances (e.g., Saskatchewan Wheat Pool and Cargill; United Grain Growers and Archer Daniels Midland), and public offerings (e.g., Saskatchewan Wheat Pool; United Grain Growers). However, these moves have resulted in the disappearances of the co-operative values in all these cases. This may suggest that if the organization wishes to remain a co-operative these external equity capital sources may not be feasible.

If agricultural co-operatives are to remain viable organizations and still maintain their co-operative values, their decision makers might need to strive to use alternative sources of equity capital. One possible recommendation to the co-operative decision makers is to revisit restrictions on residual claims (Chaddad, 2001). For example, relaxing restrictions on marketability of equity for members to be able to trade when desired may motivate them to invest in their co-operative. The lack of marketability can lead to liquidity concern and, hence, reduction in the value of equity capital (Longstaff, 1995). Members' equity should reflect the net present value of the returns members expect to receive from the co-operative over a period of time (Kelly, 2000). Paying interest on members' equity may help as an incentive to contribute capital. Allowing members of agricultural co-operatives to defer paying tax on patronage dividends they receive in the form of shares until the shares are disposed of is another way of building up the equity capital required for capital investment and growth. The bottom line is getting equity capital at any cost may be a better alternative for co-operatives to remain viable.

5.3 Future Research Recommendation /Limitations

There are several ways in which the current research on Canadian agricultural supply and marketing co-operatives may be extended. For example, further research that is geared towards answering the following questions is warranted. Do the case study based findings related to agency costs of debt generalize to the larger co-operative sector? Do the results from the survey of decision makers' risk attitudes generalize to a larger and more diversified sample of managers and directors? By using an adequate sample size from diverse co-operative types and structures, more confidence may be placed in the representativeness of the study results. To explore the impact of ownership structure, it also makes sense to compare the agency costs of debt between co-operatives and investor-owned firms.

Other questions include: are there differences in efficiency between traditional co-operative and new generation co-operative structures within the same industry? Are there differences in efficiency between co-operatives and investor-owned firms in the same industry? Does ownership structure matter? By comparing the efficiency of co-operatives and investor-owned firms, the relative competitiveness of the traditional co-operative business structure may be obtained, and a comparison between traditional co-operative and new generation co-operative structure will enable one to determine the competitiveness of the traditional co-operative form relative to the new generation form. It is necessary to understand the differences in efficiency of farm product marketing and input processing between ownership types – co-operative vs. investor-owned firms – if co-operatives are to be successful. Estimates of efficiency often vary across studies using different data sources, as well as different efficiency concepts and measurement methods. Further research may allow an assessment of the robustness of results under different assumptions that are guided by theory. Due to their unique characteristics, one should use measures (concepts) that can capture both the economic performance of the co-operative and the benefits that the members derive from their co-operative. Co-operative performance, therefore, must be judged based on the members' welfare after they have received their benefits and paid their costs. The use of cost alone may not be a sufficient measure of performance because this measure cannot adequately capture the performance of the whole system.

According to principal agent theory, firms may be operating at various levels of inefficiency due to poor incentive structures. That is, a suboptimal outcome for the principal, and a suboptimal measured efficiency for the analyst, may result because of incentive incompatibility (Bogetoft, 2000). In the principal agent problem, it is generally desirable for the principal (i.e., firm owners) to accurately assess the performance of an agent in the process of determining the agent's compensation or incentive structures. For example, if the existing co-operative managers' compensation scheme is not sufficiently performance-based[2] to provide managerial incentives to maximize members' welfare, this may result in inefficiency in resource allocation/use. The investigation of the relationship between agency problems and cost efficiency may provide a different arena for policy intervention by the co-operative decision makers in particular or members at large. Sfiridis and Daniels (2004) examined the relative cost efficiency of stock versus mutual thrifts using a Bayesian approach. The evidence from their research suggested that mutual thrifts appear to suffer from agency costs, thus reducing cost efficiency. The empirical study in this research should be extended to investigate the impact of agency problems on co-operative efficiency.

Few studies have attempted to assess the impact of agency problems on efficiency and productivity (Gagnepain and Ivaldi, 2002; Bogetoft, 1994; Bogetoft, 1995; Bogetoft, 2000). The literature on agency problems, incentives and contracts provides a theoretical framework for the claim that some decision makers are more efficient than others (Bogetoft, 2000; Uri, 2001; Gagnepain and Ivaldi, 2002; Kim and Maksimovic, 1990b). Hutcheson and Sharpe (1998) investigated the effect of agency problems on X-efficiency of mutual company and stock-owned companies. Contrary to the expense preference hypothesis, mutually-owned societies were found to be more cost efficient than those under stock ownership. Within the principal agent framework, the relationship between the owner and the agent is characterized by asymmetric information that encourages the agent to engage in strategic behaviour that results in a suboptimal outcome for the owner of the firm, measured as inefficiency (Lovell, 2001).

One other issue that is closely related to the principal agent problem relates to the risk attitudes of co-operative management. Although the firms under investigation face risk and uncertainty, most studies ignore the impact of risk on efficiency and productivity (Hughes and Mester, 1997; Battese et al., 1997). Firms with higher risk taking incentives are expected to be more efficient even though they might be exposed to significant financial risks. For co-operative firms operating under diverse regulatory environment and business structures, ignoring risk and uncertainty may have negative consequences for the accuracy and resulting usefulness of efficiency estimates.

Future study may also focus on how debt structure (short-term vs. long-term) affects the performance of co-operative firms. The impacts of debt on firm performance may differ with respect to the relative contribution of short-term versus long-term debt to total debt. As Leland and Bjerre (1996: p988) point out:

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[2] Performance-based compensation is preferred to fixed compensation in order to give sufficient incentives to managers to maximize the value of the firm (Grossman and Hart, 1983; Jensen and Murphy, 1990).

> *... long term debt better exploits tax advantages because bankruptcy tends to occur at lower asset values. But long term debt also creates greater agency costs. ...This potential agency costs can be substantially reduced or eliminated by using shorter term debt. ...the twin dimensions of optimal capital structure, amount and maturity, represent a tradeoff between tax advantages, bankruptcy costs, and agency costs.*

Furthermore, it is appealing to explore the impact of leverage and capital structure on firm performance under different market structure settings (e.g., oligopolistic market structure). In the literature, relatively little emphasis is placed on the impact of the strategic interaction between market structure on agency costs of debt. Finally, on the grounds that the direction of causation between leverage and performance may run both ways, Granger-causality tests to test causality between leverage and performance may be appropriate.

In the introductory chapter it is noted that one of the reasons for the formation of a co-operative form of business organization is a possible reduction in market contracting costs. In this study only the impact of ownership costs/agency costs is addressed. Thus, future research that focuses on the modeling and estimation of market contracting costs is necessary so that one will be able to compare the trade-offs between the increase in agency costs and the decrease in market contracting costs. Future studies will no doubt clarify the relative importance of market contracting costs and ownership costs. Also, as indicated in the introductory chapter, increased market share contributes to decreased market contracting/transacting costs. It can, thus, be hypothesized that market share is positively related to the performance of co-operative firms.

Table 5-1: The Impact of a 100 per cent Change in Long-term Debt on Variable costs of Production for Five Cases of Western Canadian Agribusiness Co-operatives, 1974-2001

Name of Co-operative	Co-op Type	Regulatory Environment	Percentage Change	Statistically Significant
Federated Co-operative Limited	Supply	Non-supply Managed	-2.40	No
Alberta Honey Producers Co-operative	Marketing	Non-supply Managed	6.70	Yes
United Farmers of Alberta	Supply	Non-supply Managed	3.00	Yes
Lilydale Foods	Marketing	Supply Managed	0.60	No
Saskatchewan Wheat Pool	Marketing	Non-supply Managed	5.50	Yes

Table 5-2: Impacts of Divergence in Risk Attitudes and Decision Making Power of Managers and Directors on the Performance of Agribusiness Co-operative Firms

Performance Measures	Differing Risk Attitudes			
	Dominating Decision Maker		Dominated Decision Maker	
	Relatively Risk Averse	Relatively Risk Taking	Relatively Risk Averse	Relatively Risk Taking
Debt Leverage	Negative(a)	Positive(b)	Positive	Negative
Members' Welfare	Negative	Positive	Positive	Negative
Financial Risk Exposure	Negative	Positive	Positive	Negative

Note: (a) Negative implies that when risk averse decision maker dominates, divergence in risk attitudes and debt leverage are negatively related. (b) Positive indicates that when relatively risk taking decision makers dominated the decision making process, divergence in risk attitudes has a positive impact on debt leverage.

Table 5-3: Summary of Posterior Mean Cost Efficiency and Posterior Standard Deviation and the Impact of Debt Leveraging on Cost Efficiency for Agribusiness Co-operatives in Canada, 1984-2001

Type of Co-operative	Mean	Std.Dev.	Impact of Debt on Efficiency
Dairy	0.746	0.120	Negative
Grains	0.839	0.085	Negative
Fruit and Vegetable	0.720	0.116	Negative
Honey and Maple	0.853	0.073	Negative
Farm Supply	0.778	0.168	Negative
Feed Mill	0.854	0.120	Positive
Farm Petroleum	0.802	0.188	Negative

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Appendix A: Willingness to Participate Letter – English Version

March 2, 2004

Dear:

Co-operative businesses as a whole have significantly contributed to the Canadian economy. This innovative research contributes to furthering co-operative agribusinesses in Canada by developing relevant risk management tools. For co-operative firms, financial risk management is somewhat different than that of investor owned firms. The potential benefit of developing and using risk management models is an improvement in the co-operatives' understanding of their sources of business risk and an improvement in their management of market risks such as price risk, policy risk and other factors such as weather. We are contacting you to request your participation in a research study designed to develop such tools.

One of the current nation-wide research projects being conducted by the Cooperative Program in Agricultural Marketing and Business in the Department of Rural Economy, University of Alberta is a study to assess the risk attitudes of managers and Boards of Directors for agribusiness co-operatives, and the implications of these attitudes for their financial risk management. To that end, we are preparing to conduct a survey on risk attitudes of the members of the **senior management team**[1] **and Board of Directors (all corporate level)** of a number of agribusiness co-operatives. Your company's willingness to participate in this research on agribusiness firms would be greatly appreciated.

In order to facilitate our survey questionnaire distribution, we would appreciate knowing if your company would be willing to participate in the survey. To indicate your company's willingness to participate, please complete the accompanying form and fax it to **(780) 492-0268**. It would be very helpful to have this returned to us by **March 10, 2004**.

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[1] For example, for United Farmers of Alberta Co-operative Limited, the senior management team includes Chief Executive Officer, Vice-President Marketing Services, Chief Financial Officer, Vice-President Human Resources, Corporate Secretary, Petroleum Division Manager and Farm Supply Manager. For Federated Co-operative Limited, the senior management team include Chief Executive Officer, Senior Vice-President Treasurer, Senior Vice-President Corporate Affairs, Vice-President Retail Operations, Vice-President Consumer Products, Vice-President Agro Products, Vice-President Logistics, Senior Vice-President Forest Products, Senior Vice-President Refining, Vice-President Environmental & Technical Services, and Senior Vice-President Human Resources. In you have any problem, please contact Dr. Ellen Goddard.

Participants in the study will remain anonymous and survey responses will be used for academic purposes only. To protect the confidentiality of participating individuals and companies, any individual observation, the name of the firm and the name of person(s) involved in the mail survey will not appear in the survey or any publications. The questionnaire itself will consist of questions involved with hypothetical situations relating to financial decision making and attitudes towards financial risk. The survey should take approximately **30 minutes** to complete.

We believe that this research will positively contribute to the success of the agribusiness co-operative sector through development of innovative risk management tools. Your contribution to this research is very valuable and we would very much appreciate your company's willingness to participate in this research project.

As a part of our research, we would also appreciate if you could send us your company's 2001/2 and 2002/3 annual (financial) reports.

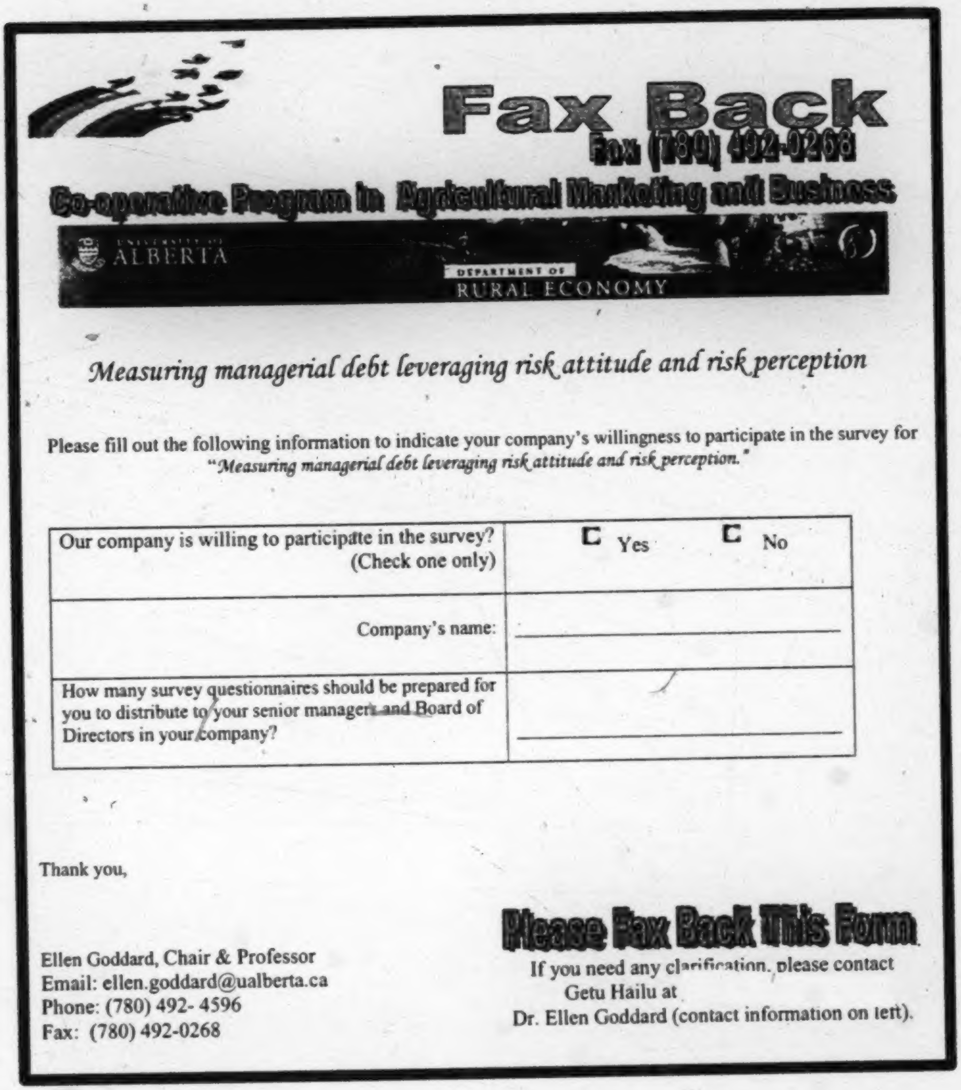
If you have any questions, please contact Dr. Ellen Goddard at 1-780-492-4596 (e-mail ellen.goddard@ualberta.ca).

Thank you for your time.

Yours sincerely,

Ellen Goddard, Chair and Professor,

Cooperative Chair in Agricultural Marketing and Business



Fax Back

Fax (780) 492-0268

Co-operative Program in Agricultural Marketing and Business

UNIVERSITY OF ALBERTA

DEPARTMENT OF RURAL ECONOMY

Measuring managerial debt leveraging risk attitude and risk perception

Please fill out the following information to indicate your company's willingness to participate in the survey for "*Measuring managerial debt leveraging risk attitude and risk perception.*"

Our company is willing to participate in the survey? (Check one only)	☐ Yes ☐ No
Company's name:	______________________
How many survey questionnaires should be prepared for you to distribute to your senior managers and Board of Directors in your company?	______________________

Thank you,

Ellen Goddard, Chair & Professor
Email: ellen.goddard@ualberta.ca
Phone: (780) 492- 4596
Fax: (780) 492-0268

Please Fax Back This Form

If you need any clarification, please contact
Getu Hailu at
Dr. Ellen Goddard (contact information on left).

Appendix B: Willingness to Participate Letter – French Version

le 01 mars, 2004

Madame, Monsieur,

Dans leur ensemble, les entreprises coopératives ont largement contribués au développement de l'économie canadienne. Par l'intermédiaire du développement d'outils d'analyse des risques associés à la gestion, ce projet de recherche innovateur se donne pour but de contribuer à l'essor des coopératives agricoles canadiennes.

La gestion des risques financiers au niveau des coopératives est différente de celles d'entreprises à capitaux privés. Le développement et l'utilisation de modèles de gestion des risques permettent de sensibiliser les entreprises coopératives au niveau des risques associés à leurs sources de revenues, ainsi que ceux liés à la tarification, aux réglementations, et autres facteurs tels que la météorologie. C'est dans ce but que nous sollicitons votre collaboration afin de poursuivre la recherche nécessaire au développement de ces outils de gestion.

Le projet de recherche mené par le programme Gestion et Marketing Agricole du Département d'Économie Rural de l'Université de l'Alberta est une étude basée sur l'évaluation du comportement des directeurs d'entreprise et autres membres des conseils d'administration face au risque ainsi que les conséquences de ces comportements liées aux risques financiers qui en découlent. Dans le cadre de cette étude, nous avons élaboré un sondage destiné aux membres du comité directeur des entreprises et du conseil d'administration et ce pour un ensemble de coopératives agricoles[1]. Par conséquent, la participation de votre organisation à ce projet serait fortement appréciée.

Afin de faciliter la distribution des questionnaires, nous vous serions gré de bien vouloir nous informer d'avance de votre participation à ce sondage. Dans le cas ou vous seriez disposé à participer, merci de bien vouloir compléter le formulaire ci-joint et de nous le faire parvenir avant le **15 mars 2004** au numéro de fax (780)-492-0286.

Nous tenons à vous assurez que les coordonnées ou autres informations personnelles de tous les participants au sondage seront traitées de manière confidentielle et que toutes les données obtenues feront l'objet d'un usage strictement académique et ce uniquement dans le cadre du projet de recherche en question. De surcroît, dans un souci de protection des individus ou des entreprises, aucune information personnelle ou liée à l'entreprise ne sera divulguée dans les publications issues de cette étude. D'ailleurs, le questionnaire en lui-même, portera sur des scénarios hypothétiques dans le cadre de décisions financières ou de comportements associés aux risques financiers. Le questionnaire ne devrait pas prendre plus de **30 minutes** à compléter.

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[1] A titre d'exemple, le comité de direction de la coopérative ***United Farmers of Alberta***, comprend son Président Directeur Général, le Directeur Général Adjoint du Service Marketing, le Directeur Général du Service Financier, le Directeur Adjoint des Ressources Humaines, le Secrétaire Corporatif, le Directeur du Secteur Pétrolier et le Directeur de l'Approvisionnement. Dans le cas de la ***Federated Co-orperative Limited***, le comité de direction comprend le Président Directeur Général, le Directeur Général Adjoint du Trésor, le Directeur Général Adjoint du Secteur Corporatif, le Directeur Général Adjoint des Ventes, le Directeur Général Adjoint du Secteur des Produits de Consommation, le Directeur Général Adjoint des Produits Agro, le Directeur Général Adjoint des Services Logistiques, le Directeur Général Adjoint des Produits Forestiers, le Directeur Général Adjoint du Service Raffinage, le Directeur Général Adjoint des Services Techniques et Environnementaux et le Directeur Général Adjoint des Ressources Humaines

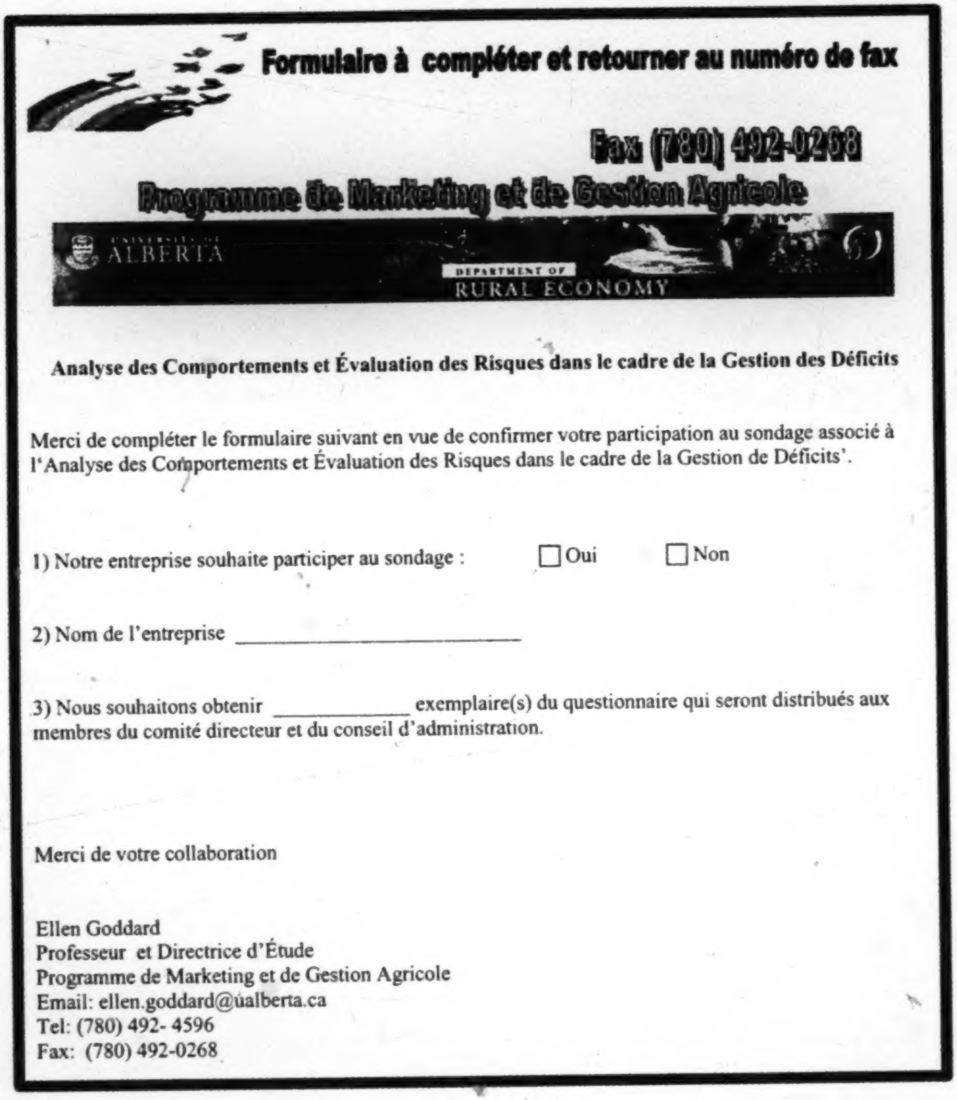
Nous sommes convaincus que ce projet de recherche et l'élaboration d'outils de gestion des risques, seront bénéfiques au secteur des coopératives agricoles. De ce fait, votre participation contribuera fortement au succès de cette étude.

Nous vous serions également reconnaissant de bien vouloir nous faire parvenir les rapports financiers de votre entreprise pour les années 2001/2002 et 2002/2003 afin de complémenter notre étude.

Dans le cas ou vous souhaiteriez obtenir d'avantages de renseignements sur l'étude en question, veuillez contacter Dr Ellen Goddard au 1-780-492-4596 (courrier électronique: ellen.goddard@ualberta.ca)

Dans l'attente d'une réponse favorable de votre part, veuillez agréer, Madame, Monsieur, à l'expression de mes sentiments les plus distingués.

Ellen Goddard
Professeur et Directrice d'Étude
Programme de Marketing et de Gestion Agricole



Formulaire à compléter et retourner au numéro de fax

Fax (780) 492-0268

Programme de Marketing et de Gestion Agricole

UNIVERSITY OF ALBERTA
DEPARTMENT OF
RURAL ECONOMY

Analyse des Comportements et Évaluation des Risques dans le cadre de la Gestion des Déficits

Merci de compléter le formulaire suivant en vue de confirmer votre participation au sondage associé à l'Analyse des Comportements et Évaluation des Risques dans le cadre de la Gestion de Déficits'.

1) Notre entreprise souhaite participer au sondage : ☐ Oui ☐ Non

2) Nom de l'entreprise ______________________________

3) Nous souhaitons obtenir ____________ exemplaire(s) du questionnaire qui seront distribués aux membres du comité directeur et du conseil d'administration.

Merci de votre collaboration

Ellen Goddard
Professeur et Directrice d'Étude
Programme de Marketing et de Gestion Agricole
Email: ellen.goddard@ualberta.ca
Tel: (780) 492- 4596
Fax: (780) 492-0268

Appendix C: Letter to the Company: English Version

March 17, 2004

Dear Sir/Madam:

Thank you very much for your willingness to participate in this important study.

Enclosed are 10 copies of the survey questionnaire that will be used in the study. Please distribute the enclosed self-addressed survey questionnaire to the senior management team and Board of Directors. It would be very helpful to have your completed questionnaires returned to us before **March 30, 2004**. If you require more survey questionnaires, please let me know.

As a part of our research, we would also appreciate it if you could send us your company's 2001/2002 and 2002/2003 annual (financial) reports.

If you have any questions, please contact Dr. Ellen Goddard at 1-780-492-4596 (e-mail ellen.goddard@ualberta.ca).

Yours sincerely,

Ellen Goddard, Chair and Professor,

Cooperative Chair in Agricultural Marketing and Business

Appendix D: Letter to the Company: French Version

17 mars 2004

Madame, Monsieur

Un grand merci pour avoir accepté de prendre part à cette importante recherche.

Vous trouverez ci-joints 10 exemplaires du sondage qui sera utilisé dans l'étude. Veuillez distribuer le questionnaire qui se trouve dans l'enveloppe-réponse à l'équipe de cadres et au conseil d'administration de votre entreprise. Il nous serait très utile de recevoir le sondage complété avant le 30 mars 2004. S'il vous faut davantage de sondages, dîtes-le moi et je vous en ferai parvenir.

Pour les besoins de notre recherche, nous aimerions savoir s'il vous serait possible de nous envoyer les rapports financiers annuels de votre entreprise pour les années 2001-2002 et 2002-2003.

Si vous avez des questions, n'hésitez pas à contacter Dr. Ellen Goddard au 1 780 492 4596 (courriel :ellen.goddard@ualberta.ca).

Cordialement,

Ellen Goddard, doyenne et professeure,

Études coopératives en Entreprises et Mise en marché agricoles

Appendix E: Information Sheet for Participants: English Version

Help us so that we may help you better.	*Have you ever considered the role a decision maker's risk attitude plays in managing your company's business?*

Project Topic: Measuring Risk Attitude and Risk Perception

Risk is an important part of the environment facing every business in the real world. If businesses are to be managed successfully, the risks and opportunities they are facing must be accurately identified and evaluated. Risk refers to situations when an individual does not know the outcome of a decision with certainty, when making that decision. This study deals with financial risk. Financial risk refers to the variability or unpredictability of net returns to the owner equity that results from financial obligations associated with debt financing. For example, a financial decision made today can create risks for the business in the future (e.g., risk of loan default).

Decisions with respect to debt financing and the resulting financial risk are influenced by the risk attitudes and perceptions of the individuals making those decisions. Having some knowledge of debt leveraging risk attitudes for decision makers within business organizations, and the factors influencing those attitudes, would provide insights that could be used to develop financial risk management tools. These tools could be utilized in order to better understand how decision makers' financial risk behavior influences the performance and viability of their business. The choice of source and structure of financial capital is a decision that has long-term consequences for any organization.

Objectives of the project

The study is part of a larger project designed to develop a risk management model for agribusiness firms in Canada. The objective of this study is to quantitatively measure the financial risk attitudes of individuals involved in financial management decisions for Canadian agribusiness firms. As well, a secondary objective is to assess factors that may influence these risk attitudes.

Methods and Information Required

In this study we are mailing a survey questionnaire to various decision-makers in Canadian agribusiness firms. Our research protocol estimates that it would require **30 minutes** to complete the questionnaire. The questions focus on risk attitudes and risk management strategies. The purpose of this research is to identify factors that affect financial risk exposure and to develop useful risk management tools that are well grounded in the actual problems faced by business decision makers.

We would appreciate your cooperation in completing the enclosed survey questionnaire. We will use well-established mail survey protocols to protect anonymity of participants. The survey results will be used in a statistical analysis that will generate aggregate relationships. Individual responses will not be used or presented in any form. We would be happy to answer any questions concerning exactly how our data analysis will be carried out. Only the primary researchers on this project will have access to the raw data provided by the mail survey. The aggregate results of the statistical analysis will be used in a Doctor of Philosophy dissertation in the Department of Rural Economy at the University of Alberta as well as in other possible publication(s) that will ensue from the research. The survey data may also be used by the principal investigators in future aggregate risk analyses of agribusiness firms.

The data gathered by the principal investigators from the survey will be combined with information from public sources (e.g., annual reports of individual firm) in further analysis. The publicly available information will be used to measure the level of financial risk exposure of a company. Variables from the survey will be used as possible factors to explain variability in the level of risk exposure. Again, the analysis will be done on an aggregate basis.

Confidentiality

To protect the confidentiality of you and your firm, the name of your firm and the name of person(s) involved in the mail survey will not appear in any publications and the firm will only be referred to by its industry affiliation (e.g., dairy industry, poultry industry, honey and maple industry). We guarantee that your identity will not be revealed. The ID of the respondents on the survey form will be replaced by our own code. Upon completion of the research, all the data will be turned over to Dr. Ellen Goddard to be safely and securely kept for five years. Dr. Ellen Goddard and Dr. Scott Jeffrey will be responsible for destroying the records at the end of the five-year period. You may decline to answer any of our questions and are free not to complete the questionnaire.

The research proposal for this study is available and can be provided upon request by you or your company. We hope you will consider participating in our research. Any questions regarding the research or the mail survey can be directed to any of the researchers listed below.

It would be very helpful to have your completed questionnaires returned to us before **May 30, 2004.**

Getu Hailu
Graduate Student
Department of Rural Economy
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1

Dr. Ellen Goddard
Professor
Department of Rural Economy
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Email: ellen.goddard@ualberta.ca
Phone: (780) 492- 4596
Fax: (780) 492-0268

Dr. Scott Jeffrey
Associate Professor
Department of Rural Economy
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Email: scott.jeffrey@ualberta.ca
Phone: (780) 492- 5470
Fax: (780) 492-0268

Appendix F: Information Sheet for Participants: French Version

Feuille de renseignements à l'intention des participants au sondage

Aidez-nous pour que nous puissions mieux vous aider.	*Avez-vous déjà analysé le rôle que joue l'attitude face au risque d'un décideur dans la gestion de votre entreprise?*

Sujet du projet: Évaluer l'attitude face au risque et la perception du risque

Dans le monde réel, le risque joue un rôle important dans l'environnement propre à chaque entreprise. Pour que les entreprises prospèrent, les opportunités et les risques auxquels elles sont confrontées doivent être identifiés et évalués de la façon la plus précise qui soit. Le risque se rapporte à des situations où un individu n'est pas certain du résultat d'une décision quand il la prend. Cette étude porte sur le risque financier. Le risque financier se rapporte à la variabilité ou l'imprévisibilité des rendements nets des capitaux propres du propriétaire qui découlent des obligations financières liées au financement par emprunt. Ainsi, une décision financière prise aujourd'hui peut comporter des risques pour l'entreprise à l'avenir (par exemple, le risque d'un défaut de paiement).

Les décisions d'un financement par emprunt et le risque financier qui en découle sont influencés par les attitudes face au risque et par la perception du risque des personnes qui prennent ces décisions. La connaissance des attitudes face au risque d'endettement des décideurs au sein d'entreprises et des facteurs qui influencent ces attitudes nous permettrait d'avoir des idées qui seraient utilisées pour élaborer des outils de gestion des risques financiers. Ces outils nous serviraient à mieux comprendre la façon dont le comportement face au risque financier des décideurs influence le rendement et la viabilité de leur entreprise. Le choix de sources et de structures du capital est une décision qui a des conséquences à long terme pour n'importe quelle entreprise.

Objectifs du projet

Cette étude fait partie d'un plus vaste projet conçu pour élaborer un modèle de gestion du risque pour les entreprises de l'agroalimentaire au Canada. L'objectif de cette étude est d'évaluer quantativement les attitudes face au risque financier des personnes qui participent aux décisions de gestion financière des entreprises agroalimentaires canadiennes. Par ailleurs, le second objectif est d'évaluer les facteurs qui pourraient influencer ces attitudes face au risque.

Méthodes et Renseignements nécessaires

Dans le cadre de cette étude, nous envoyons un sondage à divers décideurs d'entreprises agroalimentaires canadiennes. Notre protocole de recherche évalue à **30 minutes** le temps nécessaire pour répondre au questionnaire. Les questions ciblent les attitudes face au risque et les techniques de gestion du risque. Le but de cette recherche est d'identifier des facteurs qui affectent l'exposition au risque financier et d'élaborer des outils utiles de gestion du risque qui reposent sur des problèmes actuels auxquels font face les décideurs dans les entreprises.

Nous apprécions votre collaboration et votre participation à ce sondage. Nous utilisons des protocoles de sondage bien établis afin de protéger l'anonymat des participants. Les résultats du sondage seront utilisés dans une analyse statistique dont découleront des relations globales. Les réponses individuelles ne seront utilisées ni présentées d'aucune façon. Nous serions heureux de répondre aux questions que vous pourriez vous poser à propos de la façon dont nous entreprendrons notre analyse des données. Seuls nos chercheurs principaux liés au projet auront accès aux données brutes fournies dans ce sondage. Tous les résultats de cette analyse statistique seront intégrés à une thèse de doctorat du Département d'économie rurale de l'Université de l'Alberta ainsi qu'à d'autres publications possibles qui pourraient découler de cette recherche. Les données du sondage pourraient également être utilisés par les principaux chercheurs lors d'analyses globales futures des risques d'entreprises agroalimentaires.

Les données rassemblées dans le sondage par les principaux chercheurs seront combinées aux informations publiques (p.ex., rapports annuels d'entreprises individuelles) lors d'analyses plus approfondies. Les informations publiques disponibles seront utilisées pour évaluer le niveau d'exposition au risque financier d'une entreprise. Les variables du sondage seront utilisés comme facteurs possibles expliquant la variabilité du niveau d'exposition au risque. Une fois encore, cette analyse ne se fera que sur une base globale.

Confidentialité

Afin de protéger votre confidentialité ainsi que celle de votre entreprise, le nom de votre entreprise et le nom des personnes qui ont participé à ce sondage ne paraîtront dans aucune publication; l'entreprise ne sera mentionnée que par rapport à son appartenance à l'industrie (p.ex., industrie laitière, industrie avicole, industrie de l'érable et du miel). Nous garantissons que votre identité ne sera pas révélée. L'identité des répondeurs au sondage sera remplacée par notre propre code. Dès que la recherche prendra fin, toutes les données seront soumises au Dr. Ellen Goddard qui les gardera en sécurité pendant cinq ans. Les Dr. Ellen Goddard et Dr. Scott Jeffrey auront la responsabilité de détruire les dossiers à la fin de la période de cinq ans. Vous pouvez refuser de répondre à certaines questions et ne pas compléter le sondage.

La proposition de recherche pour cette étude est disponible et peut vous être fournie sur demande. Nous espérons que vous accepterez de répondre à ce sondage de recherche. Si vous avez des questions à propos de la recherche ou du sondage, vous pouvez contacter les chercheurs dont le nom se trouve ci-dessous.

Il nous serait très utile de recevoir les sondages complétés avant le **30 mars 2004**.

Getu Hailu
Étudiant de troisième cycle
Département d'Économie rurale
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1

Dr. Ellen Goddard
Professeure
Département d'Économie rurale
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Courriel : ellen.goddard@ualberta.ca
Téléphone : (780) 492- 4596
Télécopieur : (780) 492-0268

Dr. Scott Jeffrey
Professeur associé
Département d'Économie rurale
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Courriel : scott.jeffrey@ualberta.ca
Téléphone : (780) 492- 5470
Télécopieur : (780) 492-0268

Appendix G: Financial Risk Attitude Elicitation Survey: English Version

The Cooperative Program in Agricultural Marketing and Business, in the Department of Rural Economy at the University of Alberta, is undertaking research to assess the attitudes towards risk of decision makers in Canadian agribusiness firms. Improved knowledge of decision makers' risk preferences is essential to make informed predictions regarding the likely effect of alternative financial risk management policies and/or alternative capital structure and sources on business performance and viability.

In order to achieve the objectives of this project, we are conducting a survey of individual managers and members of Boards of Directors of various agribusiness firms. The study is anonymous and will be used for academic purposes only. Your name will not be identified with your questionnaire in any way. Completing the survey should take approximately 30 minutes of your time. Your participation in this survey would be greatly appreciated.

To complete the questionnaire please read the questions carefully and circle/check/write the most appropriate or accurate answers. While we would appreciate and value your responses to all questions, you may skip those questions for which you have some level of discomfort.

In you have any questions, please contact Dr. Ellen Goddard at 1-780-492-4596 (e-mail ellen.goddard@ualberta.ca) or Dr. Scott Jeffrey at 1-780-462-5470 (e-mail scott.jeffrey@ualberta.ca) or Getu Hailu at

Thank you for your time and cooperation.

Getu Hailu
Department of Rural Economy
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1

Dr. Ellen Goddard
Department of Rural Economy
515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Email: ellen.goddard@ualberta.ca
Phone: (780) 492- 4596
Fax: (780) 492-0268

Dr. Scott Jeffrey
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515 General Services Building
University of Alberta
Edmonton, AB T6G 2H1
Email: scott.jeffrey@ualberta.ca
Phone: (780) 492- 5470
Fax: (780) 492-0268

Section I

Please read each statement. Assess yourself on the basis of the degree to which the statement applies to you (most of the time) in your role as a manager or director in your company. Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very strongly disagree) and +3(= very strongly agree)**. (Please use the following scale and circle the number best indicate your feeling).

Statement	Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree	No opinion
1. When making investment decisions, I am **willing to accept** more risk to achieve higher returns and reach shareholder/member goals.	-3	-2	-1	0	+1	+2	+3	NP
2. After I make a significant business and financial decision, I normally **feel optimistic** that the decision I made will provide substantial benefits to shareholders/members.	-3	-2	-1	0	+1	+2	+3	NP
3. When it comes to business decision-making, I **like borrowing** to fund strategies although debt increases investment risks.	-3	-2	-1	0	+1	+2	+3	NP
4. In business, my **main concern** is the security of shareholders/members. Keeping **the company's money safe** is more important than earning higher returns with risk.	-3	-2	-1	0	+1	+2	+3	NP
5. I really don't let financial risk **govern** decisions when borrowing money to overcome capital constraints.	-3	-2	-1	0	+1	+2	+3	NP
6. Debt financing risk has made many companies **paranoid** about excessive debt financing.	-3	-2	-1	0	+1	+2	+3	NP
7. **Safety** is my main concern when borrowing money from banks and other sources, even when the expected benefit to the shareholders/members is very high.	-3	-2	-1	0	+1	+2	+3	NP
8. After Dairyworld, one of the largest farmer-owned western Canadian co-operatives, was sold to a private company I **worried** more about the survival of my company.	-3	-2	-1	0	+1	+2	+3	NP
9. Debt financing is **a strategy** to increase the return on equity despite the fact that it increases investment risks.	-3	-2	-1	0	+1	+2	+3	NP
10. There is a serious **financial risk exposure** problem due to excessive debt financing in my company.	-3	-2	-1	0	+1	+2	+3	NP
11. I generally **like** to suggest trying out new ideas.	-3	-2	-1	0	+1	+2	+3	NP
12. I find making decisions about taking on additional debt **difficult** when there is limited information.	-3	-2	-1	0	+1	+2	+3	NP

Section II

Please use the following information as the basis to answer questions 2.1 and 2.2.

Assume a company with the following characteristics:

Assets:	$200.4 million.
Total liabilities:	$150 million
Existing Long-Term debt:	$100 million.
Proposal:	To ensure survival it is necessary to expand the current capacity by 10% over two years.
Costs of expansion:	The expansion is expected to cost approximately $50.4 million.

2.1. If the only option to finance the expansion is through additional (100%) long-term debt, would you endorse the expansion? (Circle one only)

Definitely Not	*Possibly*	*Definitely Endorse*

2.2. If there were a choice of how to finance the recommended expansion, what proportion of long-term debt financing would you approve? (Check one only).

25% **Long-term debt financing**	**50%** **Long-term debt financing**	**75%** **Long-term debt financing**

2.3. During the next two years I will approve additional borrowing to finance new investments in the company (Circle one only).

Very unlikely	*Unlikely*	*Somewhat unlikely*	*Neutral*	*Somewhat likely*	*Likely*	*Very likely*	*No opinion*

2.4. If you were told that higher level of debt leads to higher returns to equity because of tax-benefits, how would it affect your intention to finance proposed expansions using 100% long-term debt? (Circle one only)

Would not borrow	**Not inclined to borrow**	**Less inclined to borrow**	**Neutral**	**Inclined to borrow**	**More Inclined to borrow**	**Would borrow**	**No opinion**

2.5. If you were told that the costs of borrowing are low, how would it affect your intention to finance proposed expansions using 100% long-term debt? (Circle one only)

Would not borrow	**Not inclined to borrow**	**Less inclined to borrow**	**Neutral**	**Inclined to borrow**	**More Inclined to borrow**	**Would borrow**	**No opinion**

2.6. During the next two years additional investments should be financed solely through equity. (Circle one only)

Always	**Most of the time**	**Often**	**Never**

2.7. I intend to approve additional borrowing to finance new investments in the company over the next two years. (Circle one only)

Very unlikely	**Unlikely**	**Somewhat unlikely**	**Neutral**	**Somewhat likely**	**Likely**	**Very likely**	**No Opinion**

Section III: Circle the most appropriate answer in each of the following sets of alternative responses.

1. In my opinion, financing business expansion using 100% long-term debt is:	Very bad	Bad	Somewhat bad	Neutral	Somewhat good	Good	Very good	No opinion
2. In my opinion, financing business expansion using 100% long-term debt is:	Very harmful	Harmful	Somewhat harmful	Neutral	Somewhat beneficial	Beneficial	Very Beneficial	No opinion
3. In my opinion, financing business expansion using 100% long-term debt is:	Very risky	Risky	Somewhat risky	Neutral	Somewhat safe	Safe	Very safe	No opinion
4. In my opinion, financing business expansion using 100% long-term debt is:	Very unwise	Unwise	Somewhat unwise	Neutral	Somewhat wise	Wise	Very wise	No opinion
5. In my opinion, financing business expansion using 100% long-term debt is:	Very irresponsible	Irresponsible	Somewhat irresponsible	Neutral	Somewhat responsible	Responsible	Very responsible	No opinion
6. In my opinion, financing business expansion using 100% long-term debt is:	Very incompetent	Incompetent	Somewhat incompetent	Neutral	Somewhat competent	Competent	Very competent	No opinion

Section IV: Indicate the extent of your agreement with each statement by selecting a number between -3 (**= very strongly disagree**) and **+3(= very strongly agree)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very strongly disagree	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**	**Very Strongly agree**	**No opinion**
1. Many business bankruptcies are a consequence of excessive debt.	3	-2	-1	0	+1	+2	+3	No opinion
2. There are several viable alternative financing sources for business expansion….	-3	-2	-1	0	+1	+2	+3	No opinion
3. Personally, I have seriously considered using 100% debt capital in order to finance business expansions…….	-3	-2	-1	0	+1	+2	+3	No opinion
4. The existing level of long-term debt should be checked before endorsing additional borrowing. ……………	-3	-2	-1	0	+1	+2	+3	No opinion
5. I am very concerned about the likelihood of bankruptcy arising from excessive borrowing.	-3	-2	-1	0	+1	+2	+3	No opinion
6. Since the company does not have access to many alternative financing sources, we are left with only debt financing as an option. ...	-3	-2	-1	0	+1	+2	+3	No opinion
7. Borrowing could give businesses serious problems. …………………	-3	-2	-1	0	+1	+2	+3	No opinion

Section V: Indicate the extent of your agreement with each statement by selecting a number between -3 (= **very unlikely**) and +3(= **very likely**). (Please use the following scale and circle the number that best indicate your feeling).

	Very unlikely	**Quite unlikely**	**Somewhat unlikely**	**Neither**	**Somewhat likely**	**Quite likely**	**Very likely**	**No opinion**
1. Most people who are **important to me** think that I should approve 100% long-term debt financing for business expansion. …………	-3	-2	-1	0	+1	+2	+3	No opinion
2. I am expected to endorse 100% long-term debt financing decision of the expansion. …………….	-3	-2	-1	0	+1	+2	+3	No opinion
3. Most people **in my company** whose opinions I value think that I should approve long-term debt financing for business expansion….	-3	-2	-1	0	+1	+2	+3	No opinion
4. The people **who influence what I do** think that I should approve long-term debt financing for business expansion. …………….	-3	-2	-1	0	+1	+2	+3	No opinion
5. **For me** to approve long-term debt financing for business expansion is…..	-3	-2	-1	0	+1	+2	+3	No opinion

Section VI: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very unlikely) and +3(= very likely)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very unlikely	**Unlikely**	**Somewhat unlikely**	**Neutral**	**Somewhat likely**	**Likely**	**Very likely**	**No opinion**
1. If I approve 100% long-term debt financing of expansions it will increase expected returns to **shareholder /member equity**.	-3	-2	-1	0	+1	+2	+3	No opinion
2. If I approve long-term debt financing of business expansions it will help to overcome **capital constraint problems**.	-3	-2	-1	0	+1	+2	+3	No opinion
3. If I approve long-term debt financing of business expansions it will increase **tax benefits**.	-3	-2	-1	0	+1	+2	+3	No opinion
4. If I approve long-term debt financing of business expansions it will increase **the profits of the firm**.	-3	-2	-1	0	+1	+2	+3	No opinion
5. If I approve long-term debt financing of business expansions it will increase the **likelihood of bankruptcy**.	-3	-2	-1	0	+1	+2	+3	No opinion
6. If I approve long-term debt financing of business expansions it will increase **financial risk exposure**.	-3	-2	-1	0	+1	+2	+3	No opinion
7. If I approve long-term debt financing of business expansion it will reduce **future flexibility**.	-3	-2	-1	0	+1	+2	+3	No opinion
8. If I approve long-term debt financing of business expansion it will make the expansion **a safe investment**...........	-3	-2	-1	0	+1	+2	+3	No opinion

Section VII: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very bad) and +3(= very good)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very bad	Bad	Somewhat bad	Neutral	Somewhat good	Good	Very good	No opinion
1. Increasing expected returns to shareholder/member equity is	-3	-2	-1	0	+1	+2	+3	No opinion
2. Overcoming capital constraints problems is ..	-3	-2	-1	0	+1	+2	+3	No opinion
3. Benefiting from the tax deductibility of interest charge is	-3	-2	-1	0	+1	+2	+3	No opinion
4. Increasing likelihood of bankruptcy is	-3	-2	-1	0	+1	+2	+3	No opinion
5. Increasing profit is	-3	-2	-1	0	+1	+2	+3	No opinion
6. Increasing financial risk exposure is	-3	-2	-1	0	+1	+2	+3	No opinion
7. Reducing future flexibility is	-3	-2	-1	0	+1	+2	+3	No opinion
8. Making a safe investment is	-3	-2	-1	0	+1	+2	+3	No opinion

Section VIII: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very unlikely) and +3(= very likely)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely	No opinion
1. **My colleagues** think that I should approve long-term borrowing for business expansion.....	-3	-2	-1	0	+1	+2	+3	No opinion
2. **Shareholders/Members** of the company think I should approve long-term debt to finance business expansion.	-3	-2	-1	0	+1	+2	+3	No opinion
3. **Senior management** thinks I should approve long-term debt to finance business expansion. ...	-3	-2	-1	0	+1	+2	+3	No opinion
4. **The board of directors** thinks I should approve long-term debt to finance business expansion. ...	-3	-2	-1	0	+1	+2	+3	No opinion
5. **My spouse** thinks I should approve long-term debt to finance business expansion.................	-3	-2	-1	0	+1	+2	+3	No opinion
6. **My friends** think I should approve long-term debt to finance business expansion..................	-3	-2	-1	0	+1	+2	+3	No opinion
7. **My parents** think I should approve long-term debt to finance business expansion.	-3	-2	-1	0	+1	+2	+3	No opinion

Section IX: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very unlikely) and +3(= very likely)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely	No opinion
1. Doing what my colleagues think is …….	-3	-2	-1	0	+1	+2	+3	No opinion
2. Doing what the shareholders/ members think I should do is ……..	-3	-2	-1	0	+1	+2	+3	No opinion
3. Doing what senior management thinks I should do is ………	-3	-2	-1	0	+1	+2	+3	No opinion
4. Doing what the boards of directors think I should do is …………………	-3	-2	-1	0	+1	+2	+3	No opinion
5. Doing what my spouse thinks I should do is ….	-3	-2	-1	0	+1	+2	+3	No opinion
6. Doing what my friends think I should is ………..	-3	-2	-1	0	+1	+2	+3	No opinion
7. Doing what my parents think I should do is ……….	-3	-2	-1	0	+1	+2	+3	No opinion

Section X: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very unlikely) and +3(= very likely)**. (Please use the following scale and circle the number that best indicate your feeling).

	Very unlikely	Quite unlikely	Somewhat unlikely	Neutral	Somewhat likely	Quite likely	Very likely	No opinion
1. I could approve long-term debt to finance business expansion more easily if I had more **decision-making power**…………	-3	-2	-1	0	+1	+2	+3	No opinion
2. I could approve long-term debt to finance business expansion more easily if I understood the **tax-saving benefits of borrowing** ………	-3	-2	-1	0	+1	+2	+3	No opinion
3. I could approve long-term debt to finance business expansion more easily if I understood what **the risks are**	-3	-2	-1	0	+1	+2	+3	No opinion
4. I could approve long-term debt to finance business expansion more easily if I understood what the **benefits are** …………	-3	-2	-1	0	+1	+2	+3	No opinion
5. I could approve long-term debt to finance business expansion more easily if I knew the **debt maturity structure** ……………	-3	-2	-1	0	+1	+2	+3	No opinion
6. I could approve long-term debt to finance business expansion more easily if I knew the **likelihood occurrences of bankruptcy**	-3	-2	-1	0	+1	+2	+3	No opinion
7. I could approve long-term debt to finance business expansion more easily if I knew the **level of equity reserve**………………	-3	-2	-1	0	+1	+2	+3	No opinion
8. I could approve long-term debt to finance business expansion more easily if I knew the **attitudes of shareholders/members towards borrowing**………………………	-3	-2	-1	0	+1	+2	+3	No opinion
9. I could approve long-term debt to finance business expansion more easily if I knew the **extent of interest rate risk exposure**…	-3	-2	-1	0	+1	+2	+3	No opinion
10. I could approve long-term debt to finance business expansion more easily if I knew the **term structure of interest rates** ……	-3	-2	-1	0	+1	+2	+3	No opinion
11. I could approve long-term debt to finance business expansion more easily if I knew the **costs of borrowing**…………	-3	-2	-1	0	+1	+2	+3	No opinion
12. I could approve long-term debt to finance business expansion more easily if I knew the **level of competition**…………	-3	-2	-1	0	+1	+2	+3	No opinion
13. I could approve long-term debt to finance business expansion more easily if I knew the **shareholders'/members' financial commitment** ………	-3	-2	-1	0	+1	+2	+3	No opinion

Section XI: Indicate the extent of your agreement with each statement by selecting a number between **-3 (= very strongly disagree) and +3(= very strongly agree).** (Please use the following scale and circle the number that best indicate your feeling).

	Very strongly disagree	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Very strongly agree	No opinion
1. If I want to have more **decision-making power** I can easily find out …	-3	-2	-1	0	+1	+2	+3	No opinion
2. If I want to understand the **tax-benefits of borrowing** I can easily find out …	-3	-2	-1	0	+1	+2	+3	No opinion
3. If I want to understand what the **risks of borrowing** are I can easily find out.	-3	-2	-1	0	+1	+2	+3	No opinion
4. If I want to understand what the **benefits of borrowing** are I can easily find out …	-3	-2	-1	0	+1	+2	+3	No opinion
5. If I want to know the **debt maturity structure** I can easily find out ……….	-3	-2	-1	0	+1	+2	+3	No opinion
6. If I want to know the **likelihood of occurrences of bankruptcy** I can easily find out …………………………	-3	-2	-1	0	+1	+2	+3	No opinion
7. If I want to know the **level of equity reserve** I can easily find out …………	-3	-2	-1	0	+1	+2	+3	No opinion
8. If I want to know the **attitudes of shareholders/members towards borrowing** I can easily find out ……...	-3	-2	-1	0	+1	+2	+3	No opinion
9. If I want to know the **extent of interest rate risk exposure** I can easily find out	-3	-2	-1	0	+1	+2	+3	No opinion
10. If I want to know the **term structure of interest rates** I can easily find out. ..	-3	-2	-1	0	+1	+2	+3	No opinion
11. If I want to know the **costs of borrowing** I can easily find out ……...	-3	-2	-1	0	+1	+2	+3	No opinion
12. If I want to know **level of competition** I can easily find out ……	-3	-2	-1	0	+1	+2	+3	No opinion
13. If I want to know **the shareholders'/members' financial commitment** I can easily find out	-3	-2	-1	0	+1	+2	+3	No opinion

Section XII:

1. How would you rate **your own willingness** to undertake risky business propositions as compared to other executives or board members at or near your level in your company? (Please use the following scale and indicate the number that best indicates your feeling).

Much less willing to accept risks	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Much more willing to accept risks**

2. How would you rate **your company's willingness** to undertake risky business propositions as compared to other companies in the industry? (Please use the following scale and indicate the number that best indicates your feeling).

Much less willing to accept risks	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Much more willing to accept risks**

3. In general, how easy or difficult is it for you to accept taking debt financing risks, as compared to other executives or board members at or near your level in your company?

Very easy	**Easy**	**Somewhat easy**	**Neutral**	**Somewhat difficult**	**Difficult**	**Very difficult**	**No opinion**

4. In your opinion, if your company has a very excessive level of debt financing, do you think that the survival of your company will be in danger?

Very likely	**Likely**	**Somewhat likely**	**Neutral**	**Not likely**	**Not very likely**	**Not at all likely**	**No opinion**

5. In your opinion, could excessive debt financing (i.e., debt to equity ratio greater than one) lead to serious financial risk in your company?

Very likely	**Likely**	**Somewhat likely**	**Neutral**	**Not likely**	**Not Very likely**	**Not at all likely**	**No opinion**

6. Are there any financial risk concerns or likely financial problems in your company? (Check one only)

☐ Yes	☐ No

Section XIII

1. Suppose you are given a ticket for a lottery in which the number of participants and the dollar value of the prize are specified. Please indicate how much you would be willing to pay for each ticket in the following lotteries.

Lottery	Number of Participants	Chances of winning	Prize	I would be willing to pay ($)
I	10	1 in 10	$1,000	
II	5	1 in 5	$1,000	
III	10	1 in 10	$5,000	
IV	5	1 in 5	$5,000	
V	100	1 in 100	$100,000	
VI	50	1 in 50	$100,000	

2. Suppose that you have decided to invest $10,000 in either Business A or Business B. For the following two scenarios, indicate the Business that you would choose (A or B) given the information provided:

Scenario I: Would you prefer A or B if the potential dollar gain or loss one month from now for each is as follows?

Business A		Business B	
Gain (+) or loss (-)	Likelihood of occurrence	Gain (+) or loss (-)	Likelihood of occurrence
-$500	⅓	-$500	½
+$2500	⅔	+$2500	½

Please circle **A** or **B**

Scenario II: Would you prefer A or B if the potential dollar gain or loss one month from now is as follows:

Business A		Business B	
Gain (+) or loss (-)	Likelihood of occurrence	Gain (+) or loss (-)	Likelihood of occurrence
-$500	¼	$0	½
+$500	¼		
+$1000	¼	+$1500	½
+$2000	¼		

Please circle **A** or **B**

Section XIV: 1. How familiar are you with the following risk management strategies or practices (Please use the following scale and circle the number that best indicates your feeling).

	Not at all	**Very unfamiliar**	**Unfamiliar**	**Neutral**	**Familiar**	**Very familiar**	**Extremely familiar**
	←					→	
1. Insurance	-3	-2	-1	0	+1	+2	+3
2. Derivatives	-3	-2	-1	0	+1	+2	+3
3. Forward cash contract	-3	-2	-1	0	+1	+2	+3
4. Futures market	-3	-2	-1	0	+1	+2	+3
5. Options	-3	-2	-1	0	+1	+2	+3
6. Currency swap, cap, floor or collar	-3	-2	-1	0	+1	+2	+3
7. Interest rate swap, cap, floor or collar ...	-3	-2	-1	0	+1	+2	+3
8. Commodity price swap, cap, floor or collar	-3	-2	-1	0	+1	+2	+3
9. Leasing/renting	-3	-2	-1	0	+1	+2	+3
10. Investment diversification	-3	-2	-1	0	+1	+2	+3
11. Deferred or Delayed Price Contract	-3	-2	-1	0	+1	+2	+3
12. Hedge-to-Arrive (HTA) Contract	-3	-2	-1	0	+1	+2	+3

2. How would you rate the **importance** of the following risk factors in your company during 2003? How **effectively** were these risks managed in 2003?

Risk factors	**Importance of risk management** (7=highly important, 1=not important at all)	**Effectiveness of risk management** (7=highly effective, 1=not effective at all)
1. Weather risk		
2. Commodity price risk		
3. Inventory spoilage risk		
4. Livestock disease risk		
5. Debt Leverage risk		
6. Interest rate risk		
7. Loss of key personnel risk		
8. Data accuracy risk		
9. Technology risk		
10. Regulatory risk		
11. Credit risk		
12. Net return variability risk *		
13. Foreign exchange risk		
14. Property damage/losses risk		
15. Input supply risk		
16. Market place competitiveness risk		
17. Business risks		
OTHERS please indicate		

3. In terms of the risk factors identified above, please list the **THREE** most important risks in your organization. On a scale of 1 to 7, with 7 being highly important risks, rate the importance of these risks. Ask yourself how effectively that risk is managed in your organization. Again, use a scale of 1 to 7, with 7 implying that the risk is managed extremely well and 1 implying that the risk is not managed at all.

Three most important risks	**Importance of risk management** (7=highly important, 1=not important at all)	**Effectiveness of risk management** (7=highly effective, 1=not effective at all)
1.		
2.		
3.		

Section XV: General Business information

1. How many product lines do you have in your company? ____________________

2. Where is your company's head office (city/province) located? ____________________

3. Type of your company business

Manufacturing/processing	Retailing	Other please indicate
☐	☐	☐

4. Is marketing of agricultural products the primary activity of your company?

☐ Yes ☐ No

5. Does your company sell inputs to producers?

☐ Yes ☐ No

6. What is (are) the primary type(s) of product(s) handled by your company? ____________________

Section XVI: Demographic Information

1. Are you a managerial employee or a member of the Board of Directors? (Check one only)

Management	Board of Directors
☐	☐

2. What is your gender? (Check one only)

☐ Male ☐ Female

3. Marital status (check one only)

☐ Married	☐ Separated	☐ Widowed
☐ Single	☐ Divorced	☐ Common law

4. Number of dependents (children): ____________________

5. As of December 2003, into which of the following age categories do you fall? (Please check one)

☐ Under 25 ☐ 45-54
☐ 25-34 ☐ 55-64
☐ 35-44 ☐ Over 64

6. What is your highest level of schooling or educational achievement? (Please check one only)

☐ Never attended ☐ Grade School (1-8) ☐ Some High School (9-12)
☐ High School Graduate ☐ Some College ☐ College Graduate
☐ Technical School ☐ Some Graduate School ☐ Postgraduate Degree

7. Which of the following broad categories best describes your total household income from all sources before taxes and deductions in 2003? (Please check one only)

☐ Under $50,000 ☐ $50,001 – $75,000 ☐ $75,001-$10,0000
☐ $100,001 - $125,000 ☐ $125,001 - $150,000 ☐ $150,001 - $175,000
☐ $175,001 - $200,000 ☐ $200,001 - $225,000 ☐ above $225,001

8. Do you purchase travel insurance at airports before flights? (Please circle one only)

Always	Most of the time	Often	Never

9. Please indicate the number of times in the last 12 months that you have engaged in any of the following activities

Activities	Number of times
Gambling in established casinos (Las Vegas, Bahamas, Monte Carlo etc.)	
Betting on own recreational activities (golf, poker, etc.)	
Betting on professional sports (football, baseball, hockey, horse racing etc.)	
Buying Lottery ticket (e.g., Super 7, Jackpot, Lotto, Video Lottery Terminal, etc.,)	
Playing 50/50 for charity	

10. Please indicate your current Job Title and the length of time in this position with this company.

Current job title	
Length of time in your current company	
Length of time in your current position	

11. In what Functional area of business have you spent most of your career? (e.g. Finance, marketing, accounting, production, farming, etc.)

____

12. If you are an employee of a company, is your managerial compensation in any way linked to sales, profits, etc in your company? (Check one only)

☐ Yes ☐ No

Thank you again!

Appendix H: Sondage sur les attitudes face aux risques financiers

Le programme coopératif d'*Entreprises et Mise en marché agricoles* du département d'Économie rurale de l'Université de l'Alberta entreprend des recherches pour évaluer les attitudes face au risque des décideurs au sein d' entreprises de l'industrie agroalimentaire. Une meilleure connaissance des préférences des décideurs quant aux risques est essentielle pour faire des prédictions éclairées sur l'effet probable de différentes politiques de gestion des risques financiers et/ou de sources et de structures du capital différentes sur le rendement et la viabilité de l'entreprise.

Afin d'atteindre les objectifs de ce projet, nous effectuons un sondage auprès des gestionnaires individuels et des membres des conseils d'administration d'entreprises variées de l'industrie agroalimentaire. L'étude est anonyme et ne sera utilisée qu'à des fins universitaires seulement. Votre nom n'apparaîtra pas dans le questionnaire sous quelque forme que ce soit. Il ne vous faudra que 30 minutes environ pour compléter ce questionnaire. Votre participation à ce sondage sera grandement apprécié.

Pour compléter ce questionnaire, veuillez lire attentivement les questions et encercler/cocher/écrire la réponse qui vous semble la plus appropriée ou la plus précise. Nous apprécions et respectons vos réponses à toutes les questions mais vous pouvez omettre de répondre aux questions qui vous mettent mal à l'aise.

Si vous avez des questions, n'hésitez pas à contacter Dr. Ellen Goddard au 1 780 492 4596 (courriel ellen.goddard@ualberta.ca) ou Dr. Scott Jeffrey au 1 780 462 5470 (courriel scott.jeffrey@ualberta.ca) ou Getu Hailu à l'adresse suivante : hgetu@ualberta.ca .

Nous vous remercions de prendre le temps de répondre à ce sondage et pour votre coopération.

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Section I:

Veuillez lire chaque énoncé. Faites une évaluation sur la base du degré auquel l'énoncé s'applique à vous (la plupart du temps) dans votre rôle de cadre ou d'administrateur de votre entreprise. Indiquez à quel point vous êets d'accord pour chaque énoncé en choisissant un nombre entre **–3 (absolument pas d'accord) et +3 (=tout à fait d'accord).** (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

Énoncé	Absolument pas d'accord	Pas d'accord	Plutôt pas d'accord	Neutre	Plutôt d'accord	D'accord	Absolument d'accord	Sans opinion
1. Lorsque je prends des décisions d'investissements, je **suis prêt(e) à accepter** plus de risques pour obtenir un plus grand rendement des investissements et atteindre les objectifs des membres/actionnaires.	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. Après avoir pris une importante décision financière et opérationnelle, je suis habituellement optimiste et pense que la décision que j'ai prise offrira des bénéfices importants aux membres/actionnaires.	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. En ce qui concerne les décisions opérationnelles, j'aime emprunter pour financer des stratégies même si une dette accroît les risques d'investissements.	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. En affaires, ma principale préoccupation est la sécurité des membres/actionnaires. Sécuriser l'argent de l'entreprise est plus important qu'obtenir un plus grand rendement sur capital investi avec risques.	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. Je ne permets pas que le risque financier dicte mes décisions lorsque j'emprunte de l'argent pour surmonter les contraintes de capital.	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. Le risque du financement par emprunt a rendu certaines entreprises paranoïaques au sujet des financements par emprunt excessifs.	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. La sécurité est ma préoccupation principale quand j'emprunte de l'argent auprès des banques et d'autres sources, même lorsque les bénéfices attendus pour les membres/actionnaires sont très élevés.	-3	-2	-1	0	+1	+2	+3	Sans opinion
8. Après que Dairyworld, l'une des plus grandes coopératives canadiennes de l'ouest détenues par les agriculteurs, a été vendue à une entreprise privée, je me suis beaucoup inquiété(e) à propos de la survie de mon entreprise.	-3	-2	-1	0	+1	+2	+3	Sans opinion

9. Le financement par emprunt est une **stratégie** qui augmente le rendement des capitaux propres malgré le fait qu'il accroît les risques d'investissements.	-3	-2	-1	0	+1	+2	+3	Sans opinion
10. Il y a un sérieux problème d'exposition aux risques financiers à cause d'un financement par emprunt excessif au sein de mon entreprise.	-3	-2	-1	0	+1	+2	+3	Sans opinion
11. En général, j'aime suggérer d'essayer de nouvelles idées.	-3	-2	-1	0	+1	+2	+3	Sans opinion
12. Lorsque les informations sont limitées, je trouve **difficile** de prendre des décisions à propos d'une dette supplémentaire.	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section II

Veuillez vous servir des informations suivantes comme base pour répondre aux questions **2.1 et 2.2**.
Supposons qu'une entreprise présente les caractéristiques suivantes :

Actifs :	200,4 M$
Total du passif :	150 M$
Dette à long terme existante :	100 M$
Proposition :	Pour assurer la survie, il est nécessaire d'accroître la capacité actuelle de 10 % sur deux ans.
Coûts de l'expansion :	L'expansion devrait coûter 50,4 M$ environ.

2.1. Si la seule option pour financer l'expansion est de contracter une dette à long terme supplémentaire (100 %), accepteriez-vous l'expansion? (N'encerclez qu'une réponse)

Certainement pas	*Possiblement*	*Accepte certainement*

2.2. S'il y avait un choix quant au financement de l'expansion recommandée, quelle proportion de financement par emprunt à long terme accepteriez-vous? (Ne cochez qu'une réponse)

25% de financement par emprunt à long terme	**50% de financement par emprunt à long terme**	**75% de financement par emprunt à long terme**

2.3. Au cours des deux prochaines années, j'accepterai de faire des emprunts supplémentaires pour financer de nouveaux investissements au sein de l'entreprise (n'encercler qu'une réponse).

Très improbable	*improbable*	*Plutôt improbable*	*Neutre*	*Plutôt probable*	*probable*	*Très probable*	*Sans opinion*

2.4. Si l'on vous disait qu'un plus haut niveau de dette conduisait à un meilleur rendement de capitaux propres en raison des avantages fiscaux, comment cela affecterait-il votre intention de financer les expansions proposées à l'aide d'une dette à long terme de 100 %? (N'encerclez qu'une réponse)

Je n'emprunterais pas	**Je ne serais pas disposé(e) à emprunter**	**Moins disposé(e) à emprunter**	**Neutre**	**Disposé(e) à emprunter**	**Plus disposé(e) à emprunter**	**J'emprunterais**	**Sans opinion**

2.5. Si l'on vous disait que les coûts liés à un emprunt sont faibles, comment cela affecterait-il votre intention de financer les expansions proposées à l'aide d'une dette à long terme de 100 %? (N'encerclez qu'une réponse)

Je n'emprunterais pas	**Pas disposé(e) à emprunter**	**Moins disposé(e) à emprunter**	**Neutre**	**Disposé(e) à emprunter**	**Plus disposé(e) à emprunter**	**J'emprunterais**	**Sans opinion**

2.6. Au cours des deux prochaines années, les investissements supplémentaires devraient être financés uniquement à partir de capitaux propres. (N'encerclez qu'une réponse)

Toujours	**La plupart du temps**	**Souvent**	**Jamais**

2.7. Au cours des deux prochaines années, j'ai l'intention d'accepter un emprunt supplémentaire pour financer de nouveaux investissements au sein de l'entreprise (n'encercler qu'une réponse).

Très improbable	**Improbable**	**Plutôt improbable**	**Neutre**	**Plutôt probable**	**Probable**	**Très probable**	**Sans opinion**

Section III : Encerclez la meilleure réponse pour chacun des ensembles suivants de réponses.

1. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très mauvais	Mauvais	Plutôt mauvais	Neutre	Plutôt bon	Bon	Très bon	Sans opinion
2. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très nuisible	Nuisible	Plutôt nuisible	Neutre	Plutôt avantageux	Avantageux	Très avantageux	Sans opinion
3. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très risqué	Risqué	Plutôt risqué	Neutre	Plutôt sûr	Sûr	Très sûr	Sans opinion
4. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très imprudent	Imprudent	Plutôt imprudent	Neutre	Plutôt prudent	Prudent	Très prudent	Sans opinion
5. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très irresponsable	Irresponsable	Plutôt irresponsable	Neutre	Plutôt responsable	Responsable	Très responsable	Sans opinion
6. À mon avis, financer l'expansion de l'entreprise à l'aide d'une dette à long terme à 100 % est :	Très incompétent	Incompétent	Plutôt incompétent	Neutre	Plutôt compétent	Compétent	Très compétent	Sans opinion

Section IV : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre –3 (absolument pas d'accord) et +3 (=tout à fait d'accord). (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Absolument pas d'accord	**Pas d'accord**	**Plutôt pas d'accord**	**Neutre**	**Plutôt d'accord**	**D'accord**	**Absolument d'accord**	**Sans opinion**
1. La faillite de nombreuses entreprises est la conséquence d'une dette excessive.	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
2. Il y a plusieurs sources alternatives de financement viables pour l'expansion d'une entreprise…	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
3. Personnellement, j'ai sérieusement envisagé d'utiliser des capitaux empruntés à 100 % afin de financer les expansions de l'entreprise…	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
3. Le niveau existant d'une dette à long terme devrait être vérifié avant d'accepter un emprunt supplémentaire. ……………	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
4. Je suis très inquiet/inquiète quant à la probabilité d'une faillite découlant d'un emprunt excessif. ………	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
5. Puisque l'entreprise n'a pas accès à de nombreuses sources différentes de financement, il ne nous reste que l'option d'un financement par emprunt.	-3	-2	-1	0	+1	+2	+3	**Sans opinion**
6. L'emprunt peut provoquer de graves problèmes pour les entreprises. ……	-3	-2	-1	0	+1	+2	+3	**Sans opinion**

Section V : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre –3 (très improbable) et +3 (= très probable). (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très improbable	Assez improbable	Plutôt improbable	Ni l'un ni l'autre	Plutôt probable	Assez probable	Très probable	Sans opinion
6. La plupart des personnes qui sont importantes pour moi pensent que je devrais accepter un financement par emprunt à 100 % pour l'expansion de l'entreprise.	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. On attend de moi que j'approuve la décision d'un financement par emprunt à long terme de 100 % de l'expansion.	-3	-2	-1	0	+1	+2	+3	Sans opinion
8. La plupart des personnes de **mon entreprise** dont je respecte l'opinion pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise.	-3	-2	-1	0	+1	+2	+3	Sans opinion
9. La plupart des personnes **qui ont de l'influence sur ce que je fais** pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise.	-3	-2	-1	0	+1	+2	+3	Sans opinion
10. **Pour moi,** accepter un financement par emprunt pour l'expansion de l'entreprise, ce serait . . .	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section VI : Indiquez l'étendue à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre –3 (très improbable) et +3 (= très probable). (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très improbable	**improbable**	**Assez improbable**	**Neutre**	**Quelque peu probable**	**probable**	**Très probable**	**Sans opinion**
9. Si j'approuve le financement par emprunt à long terme à 100 % des expansions, cela augmentera les rendements attendus pour les capitaux propres des membres/actionnaires. ……	-3	-2	-1	0	+1	+2	+3	Sans opinion
10. Si j'approuve le financement par emprunt à long terme des expansions de l'entreprise, cela permettra de surmonter les problèmes de contraintes de capitaux. …………	-3	-2	-1	0	+1	+2	+3	Sans opinion
11. Si j'approuve le financement par emprunt à long terme des expansions de l'entreprise, cela permettra d'augmenter les **avantages fiscaux**. ……	-3	-2	-1	0	+1	+2	+3	Sans opinion
12. Si j'approuve le financement par emprunt à long terme des expansions de l'entreprise, cela augmentera les **profits de l'entreprise**. ……	-3	-2	-1	0	+1	+2	+3	Sans opinion
13. Si j'approuve le financement par emprunt à long terme des expansions de l'entreprise, cela augmentera la **probabilité d'une faillite**.	-3	-2	-1	0	+1	+2	+3	Sans opinion
14. Si j'approuve le financement par emprunt à long terme des expansions de l'entreprise, cela augmentera l'**exposition aux risques financiers.** …	-3	-2	-1	0	+1	+2	+3	Sans opinion
15. Si j'approuve un financement par emprunt à long terme pour l'expansion de l'entreprise, cela réduira la **flexibilité future.** …………	-3	-2	-1	0	+1	+2	+3	Sans opinion
16. Si j'approuve un financement par emprunt à long terme pour l'expansion de l'entreprise, cela fera de l'expansion un **investissement sûr**…	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section VII : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre **–3 (très mauvais) et +3 (= très bon).** (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très mauvais	**Mauvais**	**Plutôt mauvais**	**Neutre**	**Plutôt bon**	**Bon**	**Très bon**	**Sans opinion**
1. Augmenter les rendements attendus des capitaux propres des membres/actionnaires est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. Surmonter les problèmes de contraintes de capitaux est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. Bénéficier de la déductibilité fiscale des frais d'intérêts est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. Accroître la probabilité d'une faillite est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. Accroître les profits est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. Accroître l'exposition aux risques financiers est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. Réduire la flexibilité future est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
8. Faire un investissement sûr est…	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section VIII : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre **–3 (= très improbable) et +3 (= très probable)**. (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très improbable	**Assez improbable**	**Plutôt improbable**	**Neutre**	**Plutôt probable**	**Assez probable**	**Très probable**	**Sans opinion**
1. **Mes collègues** pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. .	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. **Les membres/actionnaires** de l'entreprise pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. …	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. **Les cadres dirigeants** de l'entreprise pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. …….	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. **Le conseil d'administration** de l'entreprise pense que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. .	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. **Mon/ma conjoint(e)** pense que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. ……	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. **Mes amis** pensent que je devrais accepter un financement par emprunt pour l'expansion de	-3	-2	-1	0	+1	+2	+3	Sans opinion

l'entreprise. ……								
7. Mes parents pensent que je devrais accepter un financement par emprunt pour l'expansion de l'entreprise. ..	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section IX: Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre **–3 (= très improbable) et +3 (= très probable).** (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très improbable	**Assez improbable**	**Plutôt improbable**	**Neutre**	**Plutôt probable**	**Assez probable**	**Très probable**	**Sans opinion**
1. Faire ce que pensent mes collègues est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. Faire ce que les membres/actionnaires pensent que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. Faire ce que les cadres dirigeants pensent que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. Faire ce que le conseil d'administration pense que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. Faire ce que mon/ma conjoint(e) pense que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. Faire ce que mes amis pensent que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. Faire ce que mes parents pensent que je devrais faire est…	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section X : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre **- 3 (= très improbable) et +3 (= très probable).** (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Très improbable	**Assez improbable**	**Plutôt improbable**	**Neutre**	**Plutôt probable**	**Assez probable**	**Très probable**	**Sans opinion**
1. Si j'avais plus de **pouvoir décisionnel**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. Si je comprenais les **avantages fiscaux liés à l'emprunt**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. Si je comprenais quels sont **les risques**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. Si je comprenais quels sont les **avantages**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. Si je connaissais la **structure de l'échéance de la dette**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. Si je connaissais la **probabilité d'occurrence d'une faillite**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. Si je connaissais le **niveau des réserves en capitaux propres**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
8. Si je connaissais les **positions des membres/actionnaires sur l'emprunt**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
9. Si je connaissais l'**étendue de l'exposition aux risques liés aux taux d'intérêts**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
10. Si je connaissais la **structure d' échéance des taux d'intérêt**, je pourrais approuver plus facilement le	-3	-2	-1	0	+1	+2	+3	Sans opinion

financement par emprunt à long terme de l'expansion de l'entreprise…							
11. Si je connaissais les **coûts liés à l'emprunt**, je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion
12. Si je connaissais le **niveau de concurrence,** je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise	-3	-2	-1	0	+1	+2	+3	Sans opinion
13. Si je connaissais **l'engagement financier des membres/actionnaires,** je pourrais approuver plus facilement le financement par emprunt à long terme de l'expansion de l'entreprise…	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section XI : Indiquez à quel point vous êtes d'accord pour chaque énoncé en choisissant un nombre entre **–3 (absolument pas d'accord) et +3 (= absolument d'accord).** (Veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Absolument pas d'accord	Pas du tout d'accord	Pas d'accord	Neutre	D'accord	Tout à fait d'accord	Absolument d'accord	Sans opinion
1. Si je désire avoir plus de **pouvoir décisionnel,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
2. Si je veux comprendre les **avantages fiscaux liés à l'emprunt,** je peux facilement savoir…	-3	-2	-1	0	+1	+2	+3	Sans opinion
3. Si je veux comprendre les **risques liés à l'emprunt,** je peux facilement trouver.	-3	-2	-1	0	+1	+2	+3	Sans opinion
4. Si je veux comprendre les **avantages liés à l'emprunt,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
5. Si je veux connaître la **structure d'échéance d'une dette,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
6. Si je veux connaître la **probabilité des occurrences d'une faillite,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
7. Si je veux connaître le **niveau des réserves de capitaux propres,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
8. Si je veux connaître les **positions des membres/actionnaires sur l'emprunt,** je peux facilement savoir…	-3	-2	-1	0	+1	+2	+3	Sans opinion
9. Si je veux connaître l'**étendue de l'exposition aux risques des taux d'intérêt,** je peux facilement trouver.	-3	-2	-1	0	+1	+2	+3	Sans opinion
10. Si je veux connaître la **structure d'échéance des taux d'intérêt,** je peux facilement trouver. ..	-3	-2	-1	0	+1	+2	+3	Sans opinion
11. Si je veux connaître les **coûts liés à l'emprunt** , je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
12. Si je veux connaître le **niveau de la concurrence,** je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion
13. Si je veux connaître **l'engagement financier des membres/actionnaires** , je peux facilement trouver…	-3	-2	-1	0	+1	+2	+3	Sans opinion

Section XII :

1. Comment évalueriez-vous **votre propre disposition** à mettre en œuvre des propositions d'affaires risquées comparativement à d'autres cadres ou membres du conseil d'administration qui ont le même poste que vous ou un poste qui se rapproche du vôtre? (Veuillez vous servir de l'échelle suivante et indiquer le nombre qui correspond le mieux à ce que vous ressentez).

Beaucoup moins disposé(e) à accepter les risques	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Beaucoup plus disposé(e) à accepter les risques**

2. Comment évalueriez-vous la disposition de votre propre entreprise à mettre en œuvre des propositions d'affaires risquées comparativement à d'autres entreprises dans l'industrie? (Veuillez vous servir de l'échelle suivante et indiquer le nombre qui correspond le mieux à ce que vous ressentez).

Beaucoup moins disposé(e) à accepter les risques	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Beaucoup plus disposé(e) à accepter les risques**

3. En général, est-il facile ou difficile pour vous d'accepter de prendre des risques de financement par emprunt comparativement à d'autres cadres ou membres du conseil d'administration qui ont le même poste que vous ou un poste qui se rapproche du vôtre?

Très facile	**Facile**	**Assez facile**	**Neutre**	**Assez difficile**	**Difficile**	**Très difficile**	**Sans opinion**

4. Selon vous, si votre entreprise a un niveau très excessif de financement par emprunt, pensez-vous que la survie de votre entreprise soit en danger?

Très probable	**Probable**	**Assez probable**	**Neutre**	**Pas probable**	**Pas très probable**	**Pas du tout probable**	**Sans opinion**

5. Selon vous, un financement par emprunt excessif (à savoir, où le ratio capitaux d'emprunts/capitaux propres est supérieur à un) mène-t-il à de sérieux risques financiers dans votre entreprise?

Très probable	**probable**	**Assez probable**	**Neutre**	**Pas probable**	**Pas très probable**	**Pas du tout probable**	**Sans opinion**

6. Au sein de votre entreprise, y a-t-il des inquiétudes liées aux risques financiers ou des problèmes financiers probables? (Ne cochez qu'une réponse)

☐ Oui	☐ Non

Section XIII : 1. Supposons que l'on vous donne un billet de loterie sur lequel sont spécifiés le nombre de participants à la loterie et la valeur du prix en dollars. Veuillez indiquer le montant que vous seriez prêt(e) à payer pour chaque billet dans les loteries suivantes.

Loterie	**Nombre de participants**	**Chances de gagner**	**Prix**	**Je serais prêt(e) à payer ($)**
I	10	1 sur 10	1000,00 $	
II	5	1 sur 5	1000,00 $	
III	10	1 sur 10	5000,00 $	
IV	5	1 sur 5	5000,00 $	
V	100	1 sur 100	100 000,00 $	
VI	50	1 sur 50	100 000,00 $	

2. Supposons que vous avez décidé d'investir 10 000,00 $ dans l'entreprise A ou l'entreprise B. Pour les deux scénarios suivants, indiquez l'entreprise que vous choisiriez (A ou B) selon les informations fournies :

Scénario I: Choisiriez-vous l'entreprise A ou l'entreprise B si dans un mois, à compter d'aujourd'hui, le profit ou la perte potentiels en dollars sont indiqués comme ceci?

Entreprise A		**Entreprise B**	
Profit (+) ou perte (-)	Probabilité de l'occurence	**Profit (+) ou perte (-)**	Probabilité de l'occurence
-500,00 $	⅓	**-500,00 $**	½
+2500,00 $	⅔	**+2500,00 $**	½
Veuillez encercler A ou B			

Scénario II: Choisiriez-vous l'entreprise A ou l'entreprise B si dans neuf mois, à compter d'aujourd'hui, le profit ou la perte potentiels en dollars sont indiqués comme ceci?

Entreprise A		Entreprise B	
Profit (+) ou perte (-)	Probabilité de l'occurence	Profit (+) ou perte (-)	Probabilité de l'occurence
-500,00 $	¼	0,00 $	½
+500,00 $	¼		
+1000,00 $	¼	+1500,00 $	½
+2000,00 $	¼		
Veuillez encercler A ou B			

Section XIV :

1. Connaissez-vous bien les stratégies ou les pratiques de gestion des risques suivantes (veuillez vous servir de l'échelle suivante et encercler le nombre qui correspond le mieux à ce que vous ressentez).

	Je ne connais pas du tout	**Je connais très mal**	**Je connais mal**	**Neutre**	**Je connais bien**	**Je connais très bien**	**Je suis très au courant**
1. Assurances	-3	-2	-1	0	+1	+2	+3
2. Produits dérivés	-3	-2	-1	0	+1	+2	+3
3. Transaction au comptant à terme	-3	-2	-1	0	+1	+2	+3
4. Marché à terme	-3	-2	-1	0	+1	+2	+3
5. Options	-3	-2	-1	0	+1	+2	+3
6. Échange de devises, taux plafond, taux plancher ou tunnel	-3	-2	-1	0	+1	+2	+3
7. Échange de taux d'intérêt, taux plafond, taux plancher ou tunnel	-3	-2	-1	0	+1	+2	+3
8. Échange du cours des marchandises, taux plafond, taux plancher ou tunnel	-3	-2	-1	0	+1	+2	+3
9. Bail/location	-3	-2	-1	0	+1	+2	+3
10. Diversification des investissements	-3	-2	-1	0	+1	+2	+3
11. Contrat à prix réservé ou différé	-3	-2	-1	0	+1	+2	+3
12. Contrat de marchandises à livrer/à terme seulement	-3	-2	-1	0	+1	+2	+3

2. Comment évalueriez-vous l'importance des facteurs de risques suivants au sein de votre entreprise au cours de l'année 2003? Selon quel degré d'efficacité ces risques ont-ils été gérés en 2003?

Facteurs de risque	**Importance de la gestion des risques** (7= très important, 1= pas important du tout)	**Efficacité de la gestion des risques(7= très efficace, 1=pas efficace du tout)**
1. Risque météorologique		
2. Risque lié au prix des marchandises		
3. Risque de pertes de l'inventaire		
4. Risque de maladies du bétail		
5. Risque d'endettement		
6. Risque lié au taux d'intérêt		
7. Risque de perte de personnel-clé		
8. Risque lié au degré d'exactitude des données		
9. Risque technologique		
10. Risque lié à la règlementation		
11. Risque lié au crédit		
12. Risque de variabilité du rendement net		
13. Risque lié au taux de change		
14. Risque de pertes/dommages à la propriété		
15. Risque lié à l'approvisionnement en intrants		
16. Risque de concurrence du marché		
17. Risques commerciaux		
AUTRES veuillez indiquer les autres facteurs		

3. En termes de facteurs de risques identifiés ci-dessus, veuillez noter les TROIS plus importants risques pour votre entreprise. Sur une échelle de 1 à 7, 7 étant un niveau de risque extrêmement important, évaluez l'importance de ces risques. Demandez-vous quel est le degré d'efficacité auquel ce risque est géré dans votre entreprise. Encore une fois, utilisez l'échelle de 1 à 7, 7 signifiant que le risque est géré extrêmement bien et 1 signifiant que le risque n'est pas du tout géré.

Trois risques très importants	**Importance de la gestion des risques** (7= très important, 1= pas important du tout)	**Efficacité de la gestion des risques** (7= très efficace, 1= pas du tout efficace)
1.		
2.		
3.		

Section XV: Renseignements opérationnels généraux

1. Combien de gammes de produits y a-t-il dans votre entreprise? ______________________

2. Où est situé le siège social (ville/province) de votre entreprise? ____________________________

3. Genre d'entreprise

Fabrication/transformation	Commerce de détail	AUTRES veuillez indiquer les autres genres d'entreprise
☐	☐	☐

4. La mise en marché de produits agricoles est-elle la principale activité de votre entreprise?

☐ Oui ☐ Non

5. Votre entreprise vend-elle des intrants aux producteurs?

☐ Oui ☐ Non

6. Quels sont les principaux types de produits que votre entreprise manipule? ________________________
____

Section XVI: Données démographiques

1. Occupez-vous un poste de gestionnaire ou êtes-vous membre du conseil d'administration ? (Ne cochez qu'une réponse)

Gestion ☐

Conseil d'administration ☐

2. Quel est votre sexe? (Ne cochez qu'une réponse)

☐ Homme

☐ Femme

3. Situation familiale (ne cochez qu'une réponse)

☐ Marié(e)
☐ Célibataire
☐ Séparé(e)
☐ Divorcé(e)
☐ Veuf/veuve
☐ Union libre

4. Nombre de personnes à charge (enfants) : ____________________

5. Dans quelle catégorie d'âge étiez-vous en décembre 2003? (Veuillez ne cocher qu'une seule réponse)

☐ Moins de 25 ans
☐ 25-34
☐ 35-44
☐ 45-54
☐ 55-64
☐ Plus de 64 ans

6. Quel est le plus haut niveau d'instruction que vous avez atteint? (Ne cochez qu'une réponse)

☐ Je ne suis jamais allé(e) à l'école
☐ Diplômé(e) de l'enseignement secondaire
☐ École technique
☐ École primaire (1-8)
☐ Je suis allé(e) à l'université mais je n'ai pas complété l'enseignement
☐ Je suis allé(e) à l'université mais je n'ai pas complété mes études
☐ Je suis allé(e) à l'école secondaire mais je n'ai pas complété le cycle (9-12)
☐ Diplômé(e) d'université
☐ Diplômé(e) d'études universitaires supérieures

7. Laquelle des catégories suivantes décrit le mieux le revenu total de votre ménage provenant de toutes les sources avant impôts et déductions en 2003? (Veuillez ne cocher qu'une seule réponse)

☐ Moins de 50 000,00 $
☐ 50 001,00 $ – 75 000,00 $
☐ 75 001,00 $-100 000,00 $
☐ 100 001,00 $ - 125 000,00 $
☐ 125 001,00 $ - 150 000,00 $
☐ 150 001,00 $ - 175 000,00 $
☐ 175 001,00 $ - 200 000,00 $
☐ 200 001,00 $ - 225 000,00 $
☐ Plus de 225 001,00 $

8. Souscrivez-vous une assurance-voyage à l'aéroport avant de prendre l'avion? (N'encerclez qu'une réponse)

Toujours **La plupart du temps** **Souvent** **Jamais**

9. Veuillez indiquer le nombre de fois au cours des 12 derniers mois où vous avez entrepris les activités suivantes.

Activités	Nombre de fois
Jeux de hasard dans des casinos bien établis (Las Vegas, Bahamas, Monte-Carlo, etc…)	
Parier dans des activités de loisirs (golf, poker, etc.)	
Parier sur des sports professionnels (football, baseball, hockey, courses de chevaux,etc.)	
Acheter un billet de loterie (p.ex., Super 7, Jackpot, Loto, appareils de loterie vidéo,etc.)	
Participer au tirage 50/50 pour des oeuvres de charité	

10. Veuillez indiquer la désignation de votre emploi actuel et la durée d'occupation du poste au sein de cette entreprise.

Désignation d'emploi actuel	
Depuis combien de temps travaillez-vous au sein de votre entreprise actuelle?	
Depuis combien de temps occupez-vous votre emploi actuel?	

11. Dans quel domaine commercial fonctionnel avez-vous passé le plus de temps au cours de votre carrière? (p.ex., finances, marketing, comptabilité, production, agriculture,etc.) ______________________

12. Si vous êtes l'employé(e) d'une compagnie, la méthode de rémunération des cadres est-elle liée, de quelque façon que ce soit, aux ventes, aux profits, etc, de votre compagnie? (Ne cochez qu'une réponse)

☐ Oui ☐ Non

Merci infiniment!

Appendix I: Follow-up Letter

June 10, 2004

Dear Sir/Madam:

During the first week of May 2004, **five** survey questionnaires on financial risk management were forwarded to your organization. This survey is being conducted as part of a larger research project on financial risk management for Canadian agribusiness co-operatives, being conducted by the University of Alberta. As of today, **three** completed survey questionnaires have been received from your company, leaving **two** surveys outstanding. We appreciate the cooperation of those individuals within your organization who have filled out and returned the risk management surveys. Your participation will help us to develop an innovative risk management tool.

We are writing to request your assistance in encouraging the return of completed surveys from the remaining individuals in your organization who were asked to participate in the survey. We request that those who haven't already filled out and returned the survey please do so as soon as possible. We realize this is probably a busy time of the year for many people. However, we are contacting your organization now in hopes of receiving the remaining questionnaires to enable us obtain the insights only co-operative decision-makers like you can provide. The results obtained from investing the (approximately) thirty minutes required to complete the survey will help us in conducting research targeted to agribusiness co-operative development. As noted in our original communication concerning the surveys, responses are confidential and will be combined with other data in further analysis. Information from this survey will be used to evaluate factors that influence risk management policies of co-operative firms. If any of the surveys have been misplaced, please let me know and I will replace them.

Your participation in this research project, and specifically the risk attitudes survey, is extremely important, and we would appreciate your participation in this process. Should you have any questions or concerns, feel free to contact me at your convenience. Thank you for your cooperation.

Yours sincerely,

Ellen Goddard, Chair and Professor,